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THE PORT AUTHORITY OF NY & NJ

WORLD TRADE CENTER

Design Guidelines, Specifications and Standard Details Program

HVAC

Fire Protection

Plumbing

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THE PORT AUTHORITY OF NEW YORK & NEW JERSEY

WORLD TRADE CENTER

HVAC, FIRE PROTECTION, PLUMBING

DESIGN GUIDELINES, SPECIFICATIONS AND STANDARD DETAILS

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HVAC DESIGN GUIDELINES

A. HEATING AND COOLING ENERGY

The World Trade Center cooling is provided from two central refrigeration plants: one located on Levels B-5 and B-6, consisting of seven, 7,000 tons open drive centrifugal refrigeration chillers, one located on Level B-6, consisting of five, 2,000 ton centrifugal refrigeration chillers. Piping system delivers the chilled water from the central refrigeration plants to all mechanical equipment rooms (MERs). This chilled water is provided to meet the demand of the base building design load and is generally not available for tenant use in supplemental cooling.

Supplemental cooling is also provided via nine, year-round, auxiliary condenser water systems (system 1 through 9), and one glycol cooling system (system10) with a total capacity of 3,600 tons. These systems are for the tenants' self contained air conditioning units located throughout the 1 WTC, 2 WTC, 4 WTC and 5 WTC.

The WTC complex is heated by steam energy purchased from Con Edison. Steam is supplied at 150 psig to B-6 level meter room. At the three pressure reducing stations on the B-6 level, the steam is reduced to 50 psig, It is then distributed to various MERs throughout the WTC complex.

B. BASE BUILDING DESIGN CONDITIONS

The base building systems are designed to maintain indoor conditions of not more than 74° F and 60% relative humidity when outdoor conditions are not more than 89° F Dry Bulb and 73° F Wet Bulb, and a temperature of 70° F when the outdoor temperature is 11° F. Actual cooling load presently delivered to the tenant spaces is not more than 4 watts per square foot of usable area.

The design capacities of the base building HVAC systems are based upon, and limited to, the following conditions:

1. The occupancy does not exceed one (1) person for each 100 square foot of usable area.

2. The total connected electrical demand load cannot exceed 4.3 watts per square foot of usable area for all purposes, including lighting and power.

3. Proper use of Venetian blinds or other window shading devices to control solar load.

C. GENERAL DESIGN GUIDELINES

1. Tenant spaces in 1 WTC, 2 WTC, 4 WTC and 5 WTC, with the exception of Concourse, Plaza and Mezzanine levels, are served by the base building air conditioning systems year round. The perimeter areas, which are defined as 15 feet from the exterior glass, are heated and cooled by two pipe induction unit (IU) systems. Air from the base building interior systems shall not be supplied to the perimeter areas or public corridors.

2. A maximum of 0.84 cfm per sq. ft. of usable area for 1 WTC and 2 WTC, and a maximum of 1.00 cfm per sq. ft. of usable area for 4 WTC and 5 WTC shall be designed for interior tenant spaces served by the base building air conditioning systems. Supplemental AC unit(s) shall be installed by the tenants to accommodate additional cooling loads.

3. Base building fans, with the exception of selected return air fans, are normally operated 7AM through 6PM, Monday through Friday. If off hour AC service is required on an infrequent basis, it can be arranged through the Tenant Services Division of World Trade Department, subject to a separate charge.

4. To meet tenant needs that exceed the base building design capacity or require 24 hour operation constantly, auxiliary ventilation air and condenser water systems are available in most areas of 1,2,4, and 5 WTC on a 24 hour, 7 days per week basis. Uses of these systems are subject to separate charges. Refer to Appendix A for tenant supplementary AC unit design guidelines. An auxiliary ventilation air design guideline is included in Appendix B. Tenant primary chilled water riser and taps will soon become available on the low zone of 1 WTC. Refer to paragraph 19 of this section for details.

5. Unless otherwise approved, reuse of existing AC supplementary units, fans, ducts or piping is not permitted.

6. Abandoned tenant AC units, exhaust fans, plumbing fixtures, piping, ducts, hangers, supports, etc., shall be removed all the way back to the core riser closet, the nearest active branch main, or wet columns (for plumbing pipes) and capped, sealed watertight or airtight. Abandoned reheat coils shall also be removed and duct transition shall be replaced.

7. In the Towers, the maximum size of the ducts that can pass through the trusses is 17 in. by 8 in., and will carry up to 760 cfm of air capacity if it is fed by base building air systems. See attachment HVAC-13 for detail. All

branch ducts have 7 in. collar taps.

8. Supply ducts, 17 in. x 8 in., that parallel the east and west exposures in 1 WTC and with the north and south exposures in 2 WTC shall be insulated.

9. If light troffer diffuser is selected, the Port Authority standard type 20 in. x 100 in. may be used. Refer to Attachment HVAC-14 for detail. Regular ceiling type air diffusers may also be used.

10. In Occupancy Group Class C and E areas where complete sprinkler protection is provided or where duct penetration is less than 3 sq.ft., fire dampers are not required for noncombustible ducts which pass through one hour-rated partitions. Engineer shall select the appropriate detail(s) from HVAC-3 through 9 for fire damper installation. Openings with ducts through hollow fire rated construction shall be sleeved with sheet metal of at least No.14 US Standard gauge.

11. Smoke detectors are installed in front of the intake of the interior return air ducts in the hung ceiling on each floor. When a return air duct is modified, additional smoke detectors may be required and existing smoke detectors shall be relocated accordingly. Refer to attachment HVAC-20 for detail.

12. In the Towers, new extended building public corridors shall be served from either of the two existing base building core supply air systems (CS) at each floor, not from any interior space supply air systems (IS). Generally, air is available for supply to the public corridor at 0.5 to 0.75 cfm per sq.ft., depending on the floor. A positive pressurization must be maintained. Redistribution of existing supply air from existing public area and/or enlargement to the existing corridor supply air ducts may be necessary.

13. Exhaust air shall be provided for uninterrupted power supply (UPS) battery storage room.

14. Pantry rooms shall be designed with exhaust system that effectively eliminate objectionable odors generated of food reheating equipment. Depending upon the type of reheat equipment selected, exhaust systems may be an approved combination of prefilter and charcoal filters, an approved independent duct system, or other equivalent systems meeting the requirement of New York City Building Code RS 13-3 and the Port Authority for excluding food odors from the surrounding atmosphere.

15. Automatic temperature controls, except for induction units, shall be electric or electronic type.

16. The construction documents for HVAC design including base building utility service loads, air balancing schedule/flow diagram for ASOA systems, smoke evacuation air change calculation, UPS hydrogen gas concentration calculation. kitchen fire suppression system, gas detection system, etc. shall be submitted for review.

17. For ducts. fans and AC hanging requirements, the Engineer shall select the appropriate detail(s) from attachments HVAC-21 through 28, or shall design a satisfactory support system of equivalent materials and methods of construction.

18. Unless otherwise approved, all tenant VAV boxes must be designed with a VAV bypass type.

19. Tenant supplementary AC units using new tenants' primary chilled water riser on Floors 9 through 41 in 1 WTC shall be designed at 42 deg. F chilled water supply, 54 to 58 deg. F chilled water return. System working pressure is 350 psig. Piping maximum pressure drop is 4 feet per 100 feet. Maximum total head loss across supply and return connections shall not exceed 18 psi. The riser and taps will become available in June, 1998.

20. The Engineers should use only the HVAC symbols and other PA/WTC details included in this standard on his or her drawings.

21. This HVAC standard consists of three parts: Part I - Design Guidelines, Part II - Guide Specification, and Part III - Standard Details. Material or devices not specifically designated by Part II - Guide Specifications shall be utilized in complete accord with all conditions, requirements, & limitations of their listings, and approved by the Port Authority prior to construction.

D. 1 WTC & 2 WTC (TOWER A & B)

1. Central HVAC Systems

The HVAC layout of both Tower A and Tower B is similar. The base building MERs are located on Floors 7, 41, 75, and 108. The 7th floor MER serves tenants from the 8th through 24th Floors (Zone 1). The 41st floor MER serves tenants from the 25th through 58th Floors (Zone 2). The 75th floor MER serves tenants from the 59th through 91st Floors (Zone 3). The 92nd floor through 107th floor (Zone 4) is served by a MER located on the 108th

floor. Based upon the air conditioning systems provided, a typical floor in towers can be divided into three areas: interior area, peripheral area and core area.

The interior area begins at the perimeters of the core area and extends in each direction to within 15 feet of the perimeter glass. The interior space can further be subdivided into four quadrants: NW, NE, SE, and SW. Each quadrant in the same zone is served by a common interior air handling unit (AHU). These AHUs are conventional constant air volume, variable air temperature, draw through type with air economizer control. Most terminal reheat coils on the tenant floors installed originally have been removed already. Conditioned air is supplied via low pressure ducts through air/light troffers, or regular ceiling diffusers, at a maximum rate of 0.84 cfm per square foot of usable area. Average supply air temperature is 60° F. The interior system serving each quadrant per multi-floor zone is controlled by the Port Authority through remotely adjusted thermostats located within the control zone. There is one control zone per quadrant. Standard air/light troffer, 20 in. by 100 in. size, will accommodate a maximum of 2 pairs of air pouches; each pair has a maximum capacity of 170 cfm.

The perimeter area (15 feet from the exterior glass) is heated or cooled by a 2-pipe induction unit system. In the same zone of each perimeter exposure, the primary air for induction units (IUs) is supplied by a common perimeter AHU. These conventional AHUs are constant volume, steam reheat, draw through type with air economizer control. Primary air, on each floor, is transmitted in horizonal high pressure ducts in the hung ceiling directly below the induction units. Primary air supply temperature is about 60° F during the cooling seasons. The secondary induced room air is further conditioned locally by cooled or heated secondary water coils in the induction units. Secondary water is supplied at 130° F in winter, and 60° F in summer.

Return air from both the interior and peripheral areas is drawn through open fluorescent air/light troffers into a ceiling plenum. Each 100 in. air/light fixture contains four (4) slots with a capacity of 85 cfm per slot. If the areas on both sides of demising wall or slab-to-slab partition are served by the same base building interior air supply system, return air/ transfer air openings with fire dampers (if across fire-rated construction) are required to ensure the proper return of base building interior air. Air from public corridor area shall not be transferred to the tenants' interior spaces.

Minimum outdoor air provided is: 60% for peripheral air systems serving the east and south exposures; 70% for peripheral air systems serving the north

and west exposures; and 30% for interior air systems. If additional outdoor air is required, either through Ventilation Index analysis or off-hour operations when base building fans are off, auxiliary ventilation air supply is available for most areas in both Tower A and Tower B. Refer to Appendix B for details.

Base building fans, with exception of selected return air fans, are normally operated 7AM through 6PM, Monday through Friday. Additional fan service hours can be arranged through Tenant Service Division. Circulation pumps for secondary water coils in IUs operate all times during the heating seasons.

2. Induction Units (IU)

In general, one full capacity IU is required for every two perimeter windows with the exception of corner areas, 44th and 78th skylobby floors. When changing the partition layout, some IUs may need to be changed or require modification. For a complete schedule of IUs available from the Port Authority for the Towers, see attachment HVAC-15.

The four types of IU modification listed below are typically encountered in the Towers :

a. Existing full capacity IU to be removed.

b. Existing full capacity IU to be balanced to one-half capacity.

c. Existing 1-1/2 capacity IU to be removed and replaced with a new full capacity unit.

d. Existing IU to be removed and replaced with new 1-1/2 capacity unit.

The IUs are connected in parallel between the secondary water supply and return risers, in groups of 4, 5, 6, 9 and 10, called "Bays." Each bay is equipped with 2 normally-open automatic water control valves, one on the secondary water supply (SWS) and the other on the return (SWR). See attachment HVAC-16 for the standard piping schematic.

The two water control valves in each bay are regulated by a common thermostat, pneumatically operated. Additional thermostat(s) may be installed so that each control valve can be regulated separately. Unless otherwise approved, relocation of existing thermostat(s) is not permitted.

Water piping modification and relocation of existing control valves are not permitted. Additional water control valves shall not be installed on individual induction units.

E. 4 WTC (3rd through 9th Floor, Southeast Plaza Building, SEPB)

1. Central HVAC Systems

The base building MERs are located on 9th floor and B2 level (Elev. 285'-6"). Based upon the air handling systems provided, a typical floor is divided into interior and perimeter areas.

Interior areas from the third through ninth floor are served by four separate air handling systems. The conditioned air which serves the west zone is fed by an AHU in B2 level MER via a shaft at Column F50/5. The north zone is served by an AHU located in the 9th floor MER via a shaft at Column F40/9. The south central zone is served by an AHU located in the B2 level MER via a shaft at Column F50/9. The east zone is supplied by an AHU located in the 9th floor MER via a shaft at Column F50/12. These AHUs are constant air volume, variable air temperature, terminal reheat with air economizer control.

Conditioned air is supplied via low pressure ducts through air/light troffers, or regular ceiling diffusers, at a maximum rate of 1.00 cfm per square foot of usable area. Average supply air temperature is 60° F. The interior system is controlled by the Port Authority through remotely adjusted thermostats located within the control zone. Each reheat coils is controlled by a local thermostat located on the floor. A typical standard air/light troffer, 20 in. by 100 in. size, will accommodate a maximum of 2 pairs of air pouches; each pair has a maximum capacity of 170 cfm.

The perimeter area, which is defined as 15 feet from the exterior glass from the 3rd through 9th floor, is heated or cooled by a 2-pipe induction unit system. In the same zone of each perimeter exposure, the primary air for induction units (IUs) is supplied by a common perimeter AHU. These conventional AHUs are constant volume, steam reheat, draw through type with air economizer control. Primary air, on each floor, is transmitted in horizonal high pressure ducts in the hung ceiling directly below the induction units. Primary air supply temperature is about 60° F during the cooling season. The secondary induced room air is further conditioned locally by cooled or heated secondary water coils in the induction units. Secondary water is supplied at 130° F in winter, and 60° F in summer.

Return air from both the interior and peripheral areas is drawn through open fluorescent air/light troffers into a ceiling plenum. If the areas on both sides of demising wall or slab-to-slab partition are served by the same base building interior air supply system, return air/ transfer air openings with fire dampers (if across fire-rated construction) are required to ensure the proper return of base building interior air. Air from public corridor area shall not be transferred to the tenants' interior spaces.

Minimum outdoor air provided is 70% for peripheral air systems, and 30% for interior air systems. Auxiliary ventilation air supply is available for most areas, if needed. Refer to Appendix B for details.

Base building fans are normally operated 7AM through 6PM, Monday through Friday. Additional fan service hours can be arranged through Tenant Services Division.

2. Induction Units

Induction units serving perimeter areas are installed continuously along the exterior walls. There are sixteen different types of IUs (type A through P.) Refer to base building mechanical drawing M-F-54U for a complete IU schedule. In general, no modification to existing IUs is required. Piping arrangement and control for IUs in 4 WTC are similar to the Towers. Circulation pumps for secondary water coils in IUs operate at all times during the heating seasons.

F. 5 WTC (4th through 9th Floor, Northeast Plaza Building, NEPB)

1. Central HVAC Systems

The base building MERs are located on the 9th floor and B2 level (Elev. 289'-6"). The typical floor is divided into perimeter, interior and lobby areas. The lobbies are served by two AHUs: ACS-9-12N and ACS-9-13N.

The interior areas from the 5th through part of the 9th floor are divided into west, east and south zones. The west zone is served by fans ACS-9-1N, 2N and 3N via air shafts No. 1, 2, 4, 4B, 5 and 7. The east zone is served by fans ACS-9-4N and ACS-9-5N via air shafts No. 8 and 9A. The south zone is served by fans ACS-9-6N and ACS-9-7N via air shafts No.11,12 and 13. AHUs located in the 9th floor MER are constant air volume, variable air tempeature terminal reheat type with air economizer control. The terminal reheat coils on the tenant floors installed originally were all removed.

Conditioned air is supplied via low pressure ducts through air/light troffers, or regular ceiling diffusers, at a maximum rate of 1.00 cfm per square foot of usable area. Average supply air temperature is 60° F. The interior system is controlled by the Port Authority through remotely adjusted thermostats located within the control zone. A typical standard air/light troffer, 20 in. by 100 in. size, will accommodate a maximum of 2 pairs of air pouches; each pair has a maximum capacity of 170 cfm.

Interior duct layouts for the west, east and south zones of a typical floor are shown on base building drawings ME-76, 77 and 78, respectively.

The 4th floor is served by two dual duct systems: ACS-9-10N and ACS-9-11N. Mixing boxes using hot and cold air deliver the conditioned air to the tenant areas. Each mixing box is controlled by a local thermostat.

The perimeter area, which is defined as 15 feet from the exterior glass from the 4th through 9th floor, is heated or cooled by a 2-pipe induction unit system. In the same zone of each perimeter exposure, the primary air for induction units is supplied by a common perimeter AHU. These AHUs are constant volume, steam reheat, draw through type with air economizer control. Primary air, on each floor, is transmitted in horizonal high pressure ducts in the hung ceiling directly below the induction units. Primary air supply temperature is about 60° F during the cooling seasons. The secondary induced room air is further conditioned locally by cooled or heated secondary water coils in the induction units. Secondary water is supplied at 130° F in winter, and 60° F in summer.

Return air from both the interior and peripheral areas is drawn through open fluorescent air/light troffers into a ceiling plenum. Each 100 in. air/light fixture contains four (4) slots with a capacity of 85 cfm per slot. If the areas on both sides of demising wall or slab-to-slab partition are served by the same base building interior air supply system, return air/ transfer air openings with fire dampers (if across fire-rated construction) are required to ensure the proper return of base building interior air. Air from public corridor area shall not be transferred to the tenants' interior spaces.

Minimum outdoor air provided is 70% for peripheral air systems and 30% for interior air systems. Auxiliary ventilation air supply is available for most areas, if needed. Refer to Appendix B for details.

Base building fans are normally operated 7AM through 6PM, Monday through Friday. Additional fan service hours can be arranged through Tenant Service Division.

2. Induction Units

Induction units serving perimeter area are installed continuously along the exterior walls. There are 18 different types of IUs (type A through P.) Refer to base building mechanical drawing M-E-66 for a complete list of IU schedule. In general, no modification to existing IUs is required. Piping arrangement and control for IUs in 5 WTC are similar to the Towers. Circulation pumps for secondary water coils in IUs operate at all times during the heating seasons.

G. Concourse, Plaza Level (Second Floor of 4 WTC & 5 WTC , Elev. 332'), and Mezzanine (Third Floor of 5 WTC, Elev. 347')

1. HVAC Services

For these areas, the base building services provided are: chilled water supply and return, reheat hot water supply and return, tempered outdoor air, spill air, and toilet exhaust air. Tenants shall install proprietary HVAC systems using the chilled water, reheat water, outdoor air, spill air, and toilet exhaust air provided by the Port Authority. Conditioned air from base building systems shall not be taken from public spaces to serve the tenant areas.

The chilled water supply and return temperatures shall be designed at 50° F and 60° F, respectively. The operating pressure shall be designed at 300 psig. The pressure differential between supply and return is 12 psi. The cooling capacity available is determined by the piping/outlet sizes and is shown in **Table 1**. If additional capacity is required, modification to the existing piping/outlets shall be submitted for approval.

TABLE 1
Secondary Chilled Water System Capacity

Pipe Size	Recommended Flow		Maximum Flow	
	GPM	Tons	GPM	Tons
1"	6	2.5	11	4.6
1-1/4"	12	5.0	19	8.0
1-1/2"	18	7.5	25	10.5
2"	35	14.5	42	17.5
2-1/2"	56	23	72	30
3"	100	42	129	54
3-1/2"	148	62	190	79
4"	207	86	266	111

The reheat hot water supply and return temperatures shall be designed at 180° F and 150° F, respectively. The operating pressure shall be designed at 150 psig. The pressure differential between supply and return is 6 psi. See attachment HVAC-17 for typical piping connection to heating/cooling coil detail.

The chilled water system normally operates from March 15 through December 1. An air side economizer cycle may be designed during the winter mode by using the tempered outdoor air provided by Auxiliary Service Outdoor Air systems (ASOA-XX-X) or outdoor air louvers if accessible. The tempered outdoor air from ASOA systems is preheated to 45° F during the heating season before it is delivered to the tenant spaces. Reheat hot water is provided during tenant operating hours. Cooling is not provided for outdoor air from ASOA systems in summer. Air balancing schedule/air flow diagrams (refer to attached details HVAC 18 and 19) must be selected, completed and included on the drawing for review.

Baseboard radiation shall be provided when a tenant has an exposed, outdoor glass demising wall. The central heating system shall be supplemented by a door unit heater when an exterior door is the only available access to the leasehold.

2. Smoke Purge Requirement

Smoke purge is required. Tenant proprietary HVAC systems shall have a sufficient capacity to exhaust a minimum of 10 to 12 air changes per hour or one cfm per square foot of floor area, whichever is greater.

Smoke control damper or smoke/fire combination damper shall be provided to accomplish this control. Refer to attachments HVAC-10 and 11 for damper installation detail.

The control sequence for smoke purge system operation is outlined in Section 26, Part II HVAC Guide Specification.

3. Restaurant Tenant Requirements

a. Restaurant HVAC System

1) The HVAC system shall be designed to comply with New York City Building Code, NFPA and Port Authority Requirements.

2) Refer to Section 1 HVAC Services and Section 2 Smoke Purge Requirement for general HVAC system requirements.

3) A kitchen exhaust fan may serve as a smoke purge fan.

4) Dishwasher exhaust system shall be provided and may be connected into kitchen exhaust system.

b. Kitchen Exhaust System

1) Kitchen exhaust capacity shall be at least three cfm of air per square foot of floor area, but in no case less than 150 cfm. The amount of exhaust air exhausted through the kitchen hood which is compensated directly to the hood by the make-up air shall not be credited.

2) If any existing ducts or shafts are reused, verify that the existing exhaust duct meets all requirements of RS 13-3 of NYC Building Code with regard to duct construction, thermal insulation, fire rated enclosure and the arrangement of its discharge to the outdoor. Duct upgrading shall comply with the New York City Building Code requirements.

3) Fire dampers shall not be installed in any kitchen exhaust duct.

4) The kitchen exhaust fan shall continue operation during and after the fire extinguishing system's discharge.

5) Kitchen exhaust fan control system shall be interlocked to permit gas operation (including gas pilot) only when the power exhaust is in operation.

6) Kitchen exhaust system shall be operated during all periods of cooking. The power to a kitchen exhaust fan shall be connected to the kitchen light switch to ensure fan operation whenever the space is occupied.

7) An approved, wet or dry chemical, kitchen fire suppression system shall be designed.

c. Gas Detection System

An approved gas detection system shall be designed. The design for control logic for a main gas shutdown shall include, but not be limited to, the following:

1) Actuation from fire suppression system serving cooking equipment.
2) Actuation from gas detection system panel.
3) Actuation from fire alarm panel.
4) Actuation from kitchen exhaust fan system.

HVAC GUIDE SPECIFICATIONS

This specification provides the tenant's consultant engineer with WTC requirements for the HVAC systems installed by WTC tenants. The substance of this information must appear in the construction documents as required.

1. GENERAL

A. The Port Authority/World Trade Center General Provisions & Bidding Requirements are part of this Section and Contract. All work performed hereunder shall be subject thereto.

B. All applicable codes, laws and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor who shall inform the owner, prior to submitting a proposal, of any work or materials which violate any of the above laws and regulations. Any work done by the Contractor causing such violation shall be corrected by the Contractor.

C. Investigate each space through which equipment must be moved. Where necessary, equipment shall be shipped from the manufacturer in sections of size suitable for moving through available restrictive spaces. Ascertain from building owner and tenant at what times of day equipment may be moved through all areas.

D. The Contract Drawings are generally diagrammatic and do not show all offsets, drops and rises of runs for ducts & piping. The Contractor shall allow in his price for routing of ducts and piping to avoid obstructions. Exact locations are subject to approval of Architect/Engineer. Coordination with the existing services, including those of other trades is required.

E. It is the intention of these drawings and specification to call for finished work, tested and ready for operation. All materials, work, incidental accessories or other details not shown but necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be provided by the Contractor without additional cost to the Authority.

F. Submission of a proposal shall be construed as evidence that a careful examination of the portions of the existing building, equipment, etc., which effect this work, and the access to such spaces, has been made and that the Contractor is familiar with existing conditions and difficulties that will affect

the execution of the work. Later claims shall not be made for labor, equipment or materials required because of difficulties encountered which could have been foreseen during such an examination. The on-site inspection shall verify existing ducts (sizes, clearances, etc.) and conditions.

G. Install work so as to be readily accessible for operation, maintenance and repair. Minor deviations from drawings may be made to accomplish this, but changes which involve extra cost shall not be made without approval.

H. Removal and relocation of certain existing work will be necessary for the performance of the new work. All existing conditions cannot be completely detailed on the drawings. The Contractor shall survey the site and include all changes in making up the work proposal.

I. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing facilities. Install isolation valves at a point of connection to the existing piping as needed. Provide temporary duct caps and/or connections to minimize shutdown time.

J. Connect new work to existing work in neat and an approved manner. Restore existing work disturbed while installing new work to acceptable condition as determined by Architect.

K. Disconnect, remove and/or relocate existing material, equipment and other work as noted or required for proper installation of new system.

L. All materials and equipment are to be new and first class quality unless otherwise noted and shall be in accordance with building standards.

M. All mechanical work shall be free from defects in both workmanship and materials for a period of one (1) year from date of final acceptance and shall meet all local and state codes. All defects, which develop or are discovered within this period shall be repaired by the Contractor to the satisfaction of the Engineer at no additional costs.

N. Existing ducts, pipes, insulation including vermiculite, induction units and enclosures, etc., that are damaged during construction period, whether or not due to the Contractor's negligence, shall be repaired or replaced by the Contractor and left in a condition satisfactory to the WTC Supervising Engineer.

O. All present materials, equipment and construction debris to be removed under this contract shall become the property of the Contractor with the

exception of specific equipment and apparatus such as, light troffer diffusers, round flexible ducts for air connection to light troffer, induction units, requested by the Port Authority, architect or as noted to be relocated on the drawings shall be properly disposed of by this Contractor.

P. The work in the building shall be done when and as directed, and in a manner satisfactory to the owner. The work shall be performed so as to cause the least possible inconvenience and disturbance to the present occupants.

Q. The Contractor's proposal for all work performance is regular working hours. When so directed, however, the Contractor shall install work in overtime and the additional cost to be charged therefore shall be only the "premium" portion of the wages paid.

R. Unless otherwise specifically specified, include all cutting and patching of existing floors, walls, partitions and other materials in the existing building. The Contractor shall restore these areas to a condition satisfactory to the WTC Supervising Engineer.

S. The Contractor shall completely remove abandoned tenant AC units, exhaust fans, piping, ducts, hangers, supports, etc., all the way back to the core riser closet, the nearest active branch main, and capped, sealed watertight or airtight. All resulting openings shall be properly patched, sealed and firestopped to maintain the original integrity and fire rating of all partitions, walls, etc.

T. Fire damper in ducts shall be removed upon removal of fire rated partitions. Ducts shall be properly reconnected after removal of fire damper.

U. All connections, whether inside or outside a tenant space, to the existing base building HVAC utilities, shall be provided with full sized capped outlets with shutoff valves for future use as shown on the Contract Drawings.

V. Provide removable access tile and/or access doors in hung ceilings, shafts and walls for volume and fire dampers, automatic dampers and all other base building mechanical equipment and devices that are located inside the tenant spaces due to the tenant construction work. HVAC Contractor shall furnish access location requirements to a general contractor. Access tile identification: Provide buttons, tabs, and markers to identify location of concealed valves, dampers and equipment.

W. The Contractor shall purchase the following materials from the Port Authority as required for the installation:

a. Light fixture air pouch and round flexible duct for air connection to the pouch if base building standard type is specified.

b. Induction units

X. The Contractor shall deliver all excess materials as shown below to a designated area in the WTC Complex as directed by the PA/WTC Construction Inspector:

a. Light fixture air pouch and round flexible duct for air connection to the pouch

b. Induction units

Y. The final acceptance will be made after the Contractor has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications and has furnished all required certificates of inspection and approval.

Z. The Contractor shall request condenser water floor shutdown 48 hours in advance by notifying the PA/WTD Construction Inspector who will coordinate the shutdown. The condenser water riser shutdown requires 30 working days notice. The auxiliary air riser shutdown requires a minimum of ten working days notice. The Contractor shall insure that drainage will be discharged to an approved location or receptacle without causing damage to other work and property.

AA. During the course of the construction, there may be locations where the Port Authority, with its own or by other forces, may adjust or relocate existing utility services or equipment operation shall be arranged so as to permit the adjustment or relocation of these facilities.

BB. Makes offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch on sloping lines. Furnish and install traps, air vents, drains, etc., as required to effect these offsets, transitions and changes in direction.

CC. Changes in the cross-sectional dimensions of a duct are permissible when required to meet job conditions. Maintain at least the same equivalent cross-sectional duct area in accordance with the latest edition of the ASHRAE Guide.

DD. Design and performance of components and methods specified herein shall comply with the applicable provisions of the codes, standards, and manufacturer's recommendations of the entities listed below.

PANYNJ	Port Authority of New York and New Jersey
NYCBC	New York City Building Code
NYSECC	New York State Energy Conservation Construction Code
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society for Testing Materials
ANSI	American National Standards Institute
UL	Underwriter's Laboratories, Inc.
FM	Factory Mutual.
NFPA	National Fire Protection Association.
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association.
ASME	American Society of Mechanical Engineers.
AMCA	Air Moving and Conditioning Association.
ARI	American Refrigeration Institute.
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry.

2. SCOPE OF WORK

(To be furnished by the tenant's consultant)

3. SUBMITTALS

A. Submit for Engineer's approval three (3) sets of shop drawings of ducts layouts, sheet metal designs, fire damper, smoke damper, and/or fire/smoke damper installations, AC unit's layouts, piping layouts, condenser water closet detail.

B. Submit for Engineer's approval three (3) copies of catalog cuts for all dampers, AC units, exhaust fans, air outlets, constant volume regulators, pumps, valves, accessories, thermometers, pressure gauges, thermostats, vibration isolators, pipe supports and hangers, and insulation materials.

Include NYC MEA and/or BS & A numbers on each catalog cut of applicable material or equipment.

C. Submit air/water balancing report, field pipe test reports & welder's certificates, and other field test reports.

D. The submission and approval of all As-Built drawings is the responsibility of the tenant's consultant. One (1) reproducible Mylar copy and one (1) CAD diskette (3-1/2", 1.44 MB floppy) of the approved as-built drawings, must be submitted to the TAA Project Manager in WTC Tenant Services Division for record purposes. The Mylar reproducibles must be stamped "As Built" and signed by the tenant's consultant and the Contractor.

E. Whenever equipment using base building condenser water, chilled water or auxiliary ventilation air is installed, the Contractor shall submit the following information to TAA Project Manager in WTC Tenant Services Division:

a. A copy of the name plate data for each AC unit using condenser water, each cooling coil using chilled water and each CVR using auxiliary air, including but not limited to the name of manufacturer, model number, serial number, and the rated capacity in BTU per hour, tons, or cfm. This information shall be verified by the WTC Construction Inspector after the installation is completed.

b. A copy of catalog cuts, operating manual, and/or other documents which describe all the operating characteristics of each AC unit.

4. <u>INDUCTION UNITS</u>

A. Install where shown on the Contract Drawing, a factory assembled high pressure air-water, 2-pipe induction unit, properly connected to existing primary air duct and water piping. Induction units shall be as manufactured by Carrier for the World Trade Center, Model # 36SLxxHR/JL/KL-xx, universal left or right hand. Water coil working pressure shall be 250 psig. Refer to Contract Drawings for capacities, quantities and performance data.

B. Induction units shall be purchased from the Port Authority/World Trade Center. Contact Patricia Bonny of PA/WTC at 435-7002. Induction units being returned and not reused shall be returned to the Port Authority under the direction of a construction inspector, or supervising engineer.

C. Support and fasten unit to prevent vibration, providing required wall brackets, supporting legs, and leveling devices. Unit support method shall be subject to the approval of the Engineer and be similar to the method used for the existing unit.

D. The primary air connection to the induction unit shall be made with " Thermoflex type S-TL", as manufactured by Automated Industries or approved equal, of sizes shown, but not less than the full unit inlet size. The connections shall be sealed with Minnesota Mining & Manufacture Company 800 sealant and clamped with Ideal Type 52 hose clamps, or approved equal.

E. Round flexible duct connection penetrating any fire rated enclosure or partition shall be replaced with new 4 in., 26 gauge galvanized steel circular duct, seal all joints with 3M Company 800 sealant and stainless steel adjustable type clamps. A maximum length of 4 ft.of flexible duct shall be used for connection to the induction units.

F. Water piping connected to the induction unit shall be copper ASTM B-88, soft annealed, type L. Fittings shall be standard weight, wrought copper and solder type. All soldered joints shall be made with 95-5 Tin Antimony Solder having a melting point greater than 450° F. All soldered joints shall be thoroughly cleaned before the application of the solder. All pipe insulation shall match the existing.

G. The Contractor shall provide lint screens and air transfer fittings for specified induction units.

H. The Contractor shall thoroughly clean all existing induction units in the work space by means of wire brushing and/or steam cleaning of the finned surface. Remove all dust and debris from plenum chamber, cleaning nozzles and replacing filters.

I. All existing induction unit thermostats shall be thoroughly checked for proper operation, recalibrated where required, or replaced if not functional. Only thermostats manufactured by Honeywell shall be installed in the induction units.

J. The Contractor shall adjust the performance of the induction units that are modified or replaced, and remove excessive induction units as required in the contract documents. The Contractor shall be carefully in removing the induction units, especially not to damage the piping.

K. A minimum 6 in. clearance in front of induction unit recirculation grilles be maintained to assure that the induction unit can deliver its design capacity.

5. METAL DUCTS AND ACCESSORIES

A. Except as otherwise shown or noted, all ducts and other sheet metal work shall be prime sheets of galvanized steel complies with NFPA 90A and ASTM Standards A525 and A527.

B. Ducts shall be constructed and installed in accordance with the latest edition of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Duct Construction Standards. For interior air systems, pressure classification of 2 in.w.g. static pressure may be used. Pressure classification requirement will vary for other type systems depending on the application.

C. Materials for hangers & supports, including fasteners, anchors, rods, straps trim and angles shall match the duct furnished.

D. All duct sizes shown on the Contract Drawings are clear inside dimensions. Where internal acoustical lining is required, duct sizes shall be correspondingly increased to accommodate the liner thickness so that net cross-sectional areas will not be reduced.

E. Radius elbows shall have a center line radius equal to 1-1/2 times duct width. Square elbows shall have double thickness turning vanes maximum 4 in. on center.

F. Provide flexible duct as a factory glass fiber insulated assembly with a vapor barrier jacket and a maximum thermal conductance (C-Factor) of 0.23 BTU/hr/sf/deg. F at 75° F. The vapor barrier jacket must be reinforced metalized type, polyethylene jacket is not permitted. The flexible duct must have a MEA number from the New York City. Construct flexible duct of spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum, complying with UL 181, Class 1 (maximum flame spread rate of 25, maximum smoke developed rate of 50.) Maximum of 3 ft. is permitted only for connection to diffusers.

G. Flexible connections to the supply ducts and diffuser plenum of ceiling pouches shall be sealed with 3M Company 800 sealant and clamped with Stainless Steel Ideal Type 52 clamps.

H. In Tower floors, base building branch ducts 17 in. by 8 in. have 7 in. collar taps. These collar taps shall be closed off where not used with a sheet metal cap screwed to the collar and sealed with the specified sealant.

I. All finger ducts and flexible connectors shall be at a minimum of 7 in. dia. unless otherwise indicated on Contract Drawings.

J. Horizontal ducts can be supported with hangers secured to the existing structural steel above. If auxiliary steel is required, the Contractor shall provide it. It is also acceptable to use the concrete slab above as a support for the duct hangers. The existing tabs that are embedded in the concrete are to be inspected and used in lieu of new expansion bolts wherever possible. Refer to details shown on Contract Drawings.

K. For ducts with a cross-sectional area 4 square feet or less, hangers shall be no more than 8 feet apart; for ducts with a cross-sectional area of more than 4 square feet but not over 10 square feet; hangers shall be no more than 6 feet apart; and for ducts with a cross-sectional area of more than 10 feet, hangers shall be no more than 4 feet apart. The distances between hangers shall be measured lineal along the duct.

L. All branches, take-offs and tie in to all base building ducts shall be equipped with volume controlling devices. These shall be opposed blade dampers. Splitter dampers shall only be installed where specifically indicated on the Contract Drawings.

M. Volume dampers' construction shall be quadrant type, minimum 16 gauge, galvanized steel, in accordance with the applicable requirements of the SMACNA Manual, except provide bearing at one end of damper rod and quadrant. Include approved lever operating and lockscrew locking devices, mounted at other end, and installed in accessible locations. For insulated ducts, quadrants mounted on a collar to clear insulation.

N. Unless otherwise noted, all new and existing low velocity ducts shall be sealed to meet the duct sealing requirement of seal Class C, 2 in. w.g. of SMACNA. Sealant shall be approved for under New York City Building Code.

O. All access doors shall be as per SMACNA standards. Provide access doors in insulated ducts of insulated double panel construction, not less than 20 gauge, galvanized steel. Provide access doors in uninsulated ducts of single panel construction not less than 18 gauge, galvanized steel. Provide all access doors with sponge rubber gaskets around their entire perimeter.

Access door sizes shall conform to the requirements shown on PA Standard Drawing "WTC-HVAC-12, Access Door Schedule."

P. Automatic dampers: Complete with damper linkage, outside air stream mounted, and an electric operator. Opposed blade damper, galvanized steel, with compressible edge seals to prevent leakage. Factory-assemble steel linkage and shaft with nylon or oil-impregnated bronze bearings. Motor with sufficient power to limit leakage to a maximum 10 CFM per sq. ft. At 1 in. w.g. Linkage to withstand load equal to twice maximum operating force without deflection. Damper shall be mounted in welded steel channel frame.

Q. Wire mesh screen (WMS): No. 16 USSG, 3/4 square mesh, in one in. wide galvanized steel enclosing frame. Flanged duct opening to receive frame.

R. Kitchen Exhaust Ducts:

a. The duct system shall be designed and constructed in accordance with the applicable sections of New York City Building Code Reference Standard RS-13-2 & RS-13-3/NFPA 96-1984.

b. Kitchen exhaust duct materials for removal of smoke and grease-laden vapors from commercial cooking equipment shall be black iron No. 10 U.S. gauge for all cross-sectional areas. The duct shall have all welded connections with clean-out openings, located at each change in direction and spaced 12 ft. O.C. maximum on straight run as shown on the Contract Drawings.

c. Provide 2 in. grease trap at bottom of vertical riser with a clean-out opening on vertical surface.

d. Provide access door for each duct clean-out opening area as shown on the Contract Drawings.

e. On elbow design, use smooth radius without vanes instead of mitered type.

f. Refer to Contract Drawings for duct installation details, sizes for duct side clean-out openings and duct insulation details.

g. Kitchen exhaust fire suppression system (To be furnished by the tenant's consultant)

6. FIRE DAMPERS

A. Fire resistance rating of fire dampers shall comply with NFPA 90A , UL 555 and New York City Building Code Reference Standard RS 13. Fire dampers shall be rated to maintain the rating of the fire separation.

B. Fire dampers shall be approved by New York City and labeled by Underwriters Laboratories (UL). **A copy of the New York City Material and Equipment Acceptance Division (MEA) or Board of Standards and Appeals (BS & A) Calendar Item showing approval of the proposed fire damper, if it is not manufactured by Ruskin, Greenheck, Imperial or Prefco/Hugh Richards Inc., shall be submitted for review.**

C. Fire dampers must be dynamic rated type.

D. Fire dampers placed in vertical position shall be gravity-operated. Fire dampers placed in horizontal position shall be provided with all necessary springs and latches.

E. Temperature rating of fusible link shall be 165° F for most air systems and 285° F for spill air ducts serving the Concourse & Plaza levels, unless otherwise noted on the Contract Drawings.

F. For wall/partitions having a fire resistance rating of **less than 3** hours: Fire dampers shall be Ruskin Model D-IBD2 : Style A, B, & C, Greenheck Model DFD-150, Type A, B, C & CR, DFD-155, Type C & CR, Imperial IDL Model FD 110, FD 150, Type A, B, C & CR, Prefco/Hugh Richards Inc. Model UL 75A, or approved equal. They shall be installed in accordance with the manufacturer's approved installation instructions.

For wall/partitions having a fire resistance rating of **3** hours:
Fire dampers shall be Ruskin D-IBD23 : Style A, B, & C, Greenheck Model DFD-350, Type A, B, C & CR, DFD-355, Type C & CR, Imperial IDL Model FD 310, FD 350, Type A, B, C, Prefco/Hugh Richards Inc. Model UL 75L, or approved equal. They shall be installed in accordance with the manufacturer's approved installation instructions.

G. Fire damper sleeve shall be 16 gauge for dampers with dimensions not exceeding 24 in. in height or 36 in. in width, and 14 gauge for larger sizes. Sleeve thickness must not be less than the gauge of the connecting duct. Fire damper sleeves through hollow fire-rated construction be made of at least 14 gauge sheet metal.

H. Duct to damper sleeve connections shall be breakaway style. Rectangular ducts must use one or more of the following connections: "S" slip, or other slip type, modified ductmate types (plastic cleats, no corner bolts),or modified proprietary TDC by Lockformer, or TDF by Eagle flange system (no corner bolts.) Round and oval ducts must use a 4 in. wide drawband connection. All the connections shall be listed in UL 555 and depicted in the SMACNA Fire, Smoke and Radiation Damper installation Guide.

I. Damper sleeves shall not extend more than 6 in. beyond the fire wall or partition unless fire damper is equipped with a factory installed access door. Sleeve may extend up to 16 in. beyond the fire wall or partition on sides equipped with a factory installed access door.

J. Mounting angles shall be a minimum of 1-1/2" x 1-1/2" x 14 gauge and fastened to sleeve with No. 10 sheet metal screws, 1/4" bolts and nuts, ½" long welds, or 3/16" steel pop rivets. Secure sleeves by perimeter angles on four sides of the sleeve on both sides of opening.

K. The Contractor shall seal all joints of the sleeve with sealant. The joint between taps and ducts shall be made airtight and secured by U.S. No.10 sheet metal screws (one per side of rectangular duct, or three per round duct), sealed with sealant and then taped. Fire rated sealant shall be Dow Corning Silicone # 999, # 732 RTV, GE RTV Silicone Rubber, or an approved equal.

L. Provide access doors on either side of the sleeve only to permit inspecting, testing and resetting the dampers.

M. Refer to Contract Drawings for installation details and fire damper notes.

N. Ceiling fire dampers shall be suitable for installation inside duct and surface mounting of diffusers or grilles. Ceiling fire dampers shall be Ruskin CFD, CFDR, Greenheck Model CRD-1, CRD-2, Imperial IDL Model 410, 420, 420R, Prefco Model 5600, 5660, or approved equal for wall/partitions having a fire resistance rating of less than 3 hours. Ceiling fire dampers shall be Ruskin CFD, CFDR, Greenheck Model CRD-1, CRD-2, Imperial IDL Model 410, 420, 420R, Prefco Model 5610, 5680, or approved equal for wall/partitions having a fire resistance rating of 3 hours. Hanger straps for mounting ceiling dampers shall be not less than 16 gauge,1-1/2 in. channels. Provide volume adjustment features in the fusible link to permit adjustment of damper blades to balance airflow through the damper.

7. SMOKE DAMPERS

A. Smoke dampers shall be approved by New York City and labeled by Underwriters Laboratories (UL). **A copy of the New York City Material & Equipment Acceptance Division (MEA) or Board of Standards and Appeals (BS & A) Calendar Item showing approval of the proposed smoke damper, if it is not manufactured by Ruskin, Greenheck, Imperial or Prefco, shall be submitted for review.**

B. Each smoke damper shall be classified by UL as a Leakage Rated Damper for use in smoke control systems under the latest version of UL 555S and NFPA 90A. The maximum damper leakage rating under UL 555S shall be Class II (10 CFM/sq. ft. at 1.0 in. w.g.)

C. Damper frame shall be a minimum of 16 gauge galvanized steel; the blade shall be double skin airfoil shape or single skin 16 gauge minimum galvanized steel construction with longitudinal grooves for reinforcement.

D. Factory installed damper actuators type shall be electric,120 VAC-60 Hz, externally mounted.

E. Dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250° F, 350° F, or 450° F depending upon the actuator.

F. Smoke dampers shall be Ruskin SD36, SD37, SD50, SD60, SDS25, SDRS25 or SD102, Greenheck Model SMD 22, SMD 23, SMD 43, or SMDR 53, Imperial IDL Model 661, Prefco Model 5150, or approved equal. They shall be installed in accordance with the manufacturer's approved installation instructions.

G. In no case shall the damper be installed more than 24" from the smoke barrier or after the first duct or outlet.

H. Fasten smoke damper to duct or sleeve using No. # 10 sheet metal screws, 1/4" bolts and nuts, ½" long welds, or 3/16" steel pop rivets. Attachments must be made at each flange spaced a maximum of 6" on centers and a maximum of 2" from corners on rectangular dampers, and a maximum 6" on centers on round dampers.

I. The Contractor shall seal all joints of duct or sleeve with sealant to meet UL 555S requirements. The joint between taps and ducts shall be made airtight and secured by U.S. No.10 sheet metal screws (one per side of rectangular duct, or three per round duct), sealed with sealant and then taped. Sealant

shall be Dow Corning Silicone # 732, or GE RTV #108, or approved equal.

J. Provide access doors on either side of the sleeve only to permit inspecting, testing and resetting the dampers.

K. Refer to Contract Drawings for installation details.

8. FIRE/SMOKE COMBINATION DAMPERS

A. Fire resistance rating of fire/smoke dampers shall comply with NFPA 90A, NFPA 92A , UL555, UL 555S and New York City Building Code Reference Standard RS 13. Fire/smoke dampers shall be rated to maintain the rating of the fire separation.

B. Fire/smoke dampers shall be approved by New York City and labeled by Underwriters Laboratories (UL). **A copy of the New York City Material and Equipment Acceptance Division (MEA) or Board of Standards and Appeals (BS & A) Calendar Item showing approval of the proposed fire/smoke damper, if it is not manufactured by Ruskin, Greenheck, Imperial or Prefco shall be submitted for review.**

C. Fire/smoke dampers shall have **FireStat** or similar device which allows remote override of fire induced closure to permit controlled operation in a dynamic smoke management system with damper position indicating switch. FireStat shall electrically and mechanically lock damper in a closed position when duct temperature exceeds 165° F.

D. Factory installed damper actuators type shall be electric,120 VAC-60 Hz, externally mounted.

E. The maximum damper leakage rating under UL 555S shall be Leakage Class II (10 CFM/sq. ft. at 1.0 in. w.g.)

F. Damper frame shall be a minimum of 16 gauge galvanized steel; the blades shall be single skin 16 gauge minimum galvanized with longitudinal grooves for reinforcement.

G. Dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250° F, 350° F, or 450° F depending upon the actuator.

H. The damper shall have the reopenable capability for smoke mode but automatically to the actuator rating and manually control after full fire exposure.

I. For wall/partitions having a fire resistance rating of **less than 3** hours: Fire/smoke dampers shall be Ruskin FSD60 or FSD60,Greenheck Model FSD 23, FSD 33, Imperial IDL Model 770, 771, Prefco Model 5010, or approved equal. They shall be installed in accordance with the manufacturer's approved installation instructions.

For wall/partitions having a fire resistance rating of 3 hours:

Fire/smoke dampers shall be Ruskin FSD31, Greenheck Model FSD 28, Imperial IDL Model 770, 771, Prefco Model 5010, or approved equal. They shall be installed in accordance with the manufacturer's approved installation instructions.

J. Fire/smoke damper sleeve shall be 16 gauge for dampers with dimensions not exceeding 24 in. in height or 36 in. in width, and 14 gauge for larger sizes. Sleeve thickness must not be less than the gauge of the connecting duct. Fire/smoke damper sleeves through hollow fire-rated construction be made of at least 14 gauge sheet metal.

K. Duct to damper sleeve connections shall be breakaway style. Rectangular ducts must use one or more of the following connections: "S" slip, or other slip type, modified ductmate types (plastic cleats, no corner bolts),or modified proprietary TDC by Lockformer, or TDF by Eagle flange system (no corner bolts.) Round and oval ducts must use a 4 in. wide drawband connection. All the connections shall be listed in UL 555 and depicted in the SMACNA Fire, Smoke and Radiation Damper installation Guide.

L. Damper sleeves shall not extend more than 6 in. beyond the fire wall or partition unless damper is equipped with an actuator and/or factory installed access door. Sleeve may extend up to 16 in. beyond the fire wall or partition on sides equipped with actuator and /or factory installed access door.

M. Mounting angles shall be a minimum of 1-1/2" x 1-1/2" x 14 gauge and fastened to sleeve with No.10 sheet metal screws, 1/4" bolts and nuts, ½" long welds, or 3/16" steel pop rivets. Secure sleeves by perimeter angles on four sides of the sleeve on both sides of opening.

N. The Contractor shall seal all joints of the sleeve with sealant to meet UL 555S requirements. The joint between taps and ducts shall be made airtight and secured by U.S. No.10 sheet metal screws (one per side of rectangular duct, or three per round duct), sealed with sealant and then taped. Fire rated sealant shall be Dow Corning Silicone # 999, # 732 RTV, GE RTV Silicone Rubber, or approved equal.

O. Provide access doors on either side of the sleeve to permit inspecting, testing and resetting the dampers.

P. Refer to Contract Drawings for installation details.

9. AIR TERMINAL DEVICES

A. Furnish and install all metal diffusers, grilles and registers as indicated on the Contract Drawings. All sizes, air distribution patterns and air volume capacities shall be as specified on the Contract Drawings.

B. Air diffusers in the new public corridor area shall be "PRICE," or approved equal, square ceiling diffusers, Model SPD, 12" x 12" face size, 6" dia. neck size, type 4 diffuser style for concealed spline ceiling, type 31 for lay-in ceiling. All diffusers shall be furnished with opposed blade dampers.

C. All diffusers and registers shall be prime coated steel or extruded aluminum finished, unless otherwise noted, in baked white enamel.

D. All ceiling type air diffusers shall be provided with air equalizing deflectors, fully adjustable for horizontal to vertical air flow. All return registers shall also have volume dampers. Damper operating levers shall be accessible at the face of air outlet.

E. Margin types and methods of attachment for all diffusers, grilles and registers shall be coordinated with architectural ceiling details and specifications.

F. Suitable for operation at 20% excess and 20% less than noted capacity for constant volume systems and at 20% excess and 60% less than noted capacity for variable volume systems.

G. Unless otherwise shown on the Contract Drawings, noise criteria for all air terminal devices shall not exceed Noise Criteria (NC) 35, or sound meter reading 40 dBA, measured at a location 42 in. below the center of the devices. Manufacturer is responsible for examining application of each outlet and guarantee that each will provide required NC levels and comfort space conditions without drafts throughout operating range.

H. All air terminal devices shall be Anemostat, Titus, Krueger, Tuttle & Bailey, or an approved equal.

I. Where the Port Authority Standard light fixture (20" x 100") air pouches are selected, either single or dual supply plenum, purchase from the Port Authority. Installation shall follow the details shown on the Contract Drawings.

J. Constant volume regulator for auxiliary ventilation air shall be Anemostat Model HVE with a MCV box, size xx, or Phoenix Control Corp. Air Flow Control Valve, Model CVV, designed for a minimum inlet static pressure of 3 inches w.g. for 1 WTC and 2 WTC.

10. ACOUSTIC DUCT LINER

A. Provide acoustic duct liner for the following ducts:

a. All ducts within mechanical rooms and not less than 15 ft from all fans.

b. Air transfer ducts.

c. Downstream of all variable air volume and constant volume boxes for a minimum of 10 ft.

d. All mixed air plenums, except where moisture carryover from outdoor air louver will occur.

e. Where noted on the Contract Drawings.

B. Material shall be fiberglass, minimum 3 lb. density, 1 in. thickness, maximum 0.26 K factor at 75° F mean temperature with neoprene coated finish and stenciled in accordance with NFPA 90. Flamespread shall be a maximum of 25. Similar to Johns-Manville Lina-Coustic, or an approved equal.

C. All sound-lining, adhesives, faces and accessories to be applied in accordance with manufacturers' recommendations, except as otherwise noted.

11. CEILING EXHAUST FANS

A. The Contractor shall furnish and install exhaust fans of the size and capacity as shown in the fan schedule on Contract Drawings.

B. Fans shall be a ceiling exhaust fan or in-line centrifugal cabinet blower.

C. Fans shall be hung with vibration isolators.

D. Support fans in accordance with applicable requirements of Section "Vibration Isolation", installation detail as shown on Drawings, and manufacturer's recommendations to minimize noise and vibrations.

E. Fan cabinet shall be wrapped with 1 in. acoustical lining to prevent noise from entering office areas.

F. Unless otherwise noted, fans shall be operated by a manual switch with a running pilot light.

G. Fan shall be similar or equal to those as manufactured by Greenheck, Model SP,CSP; Penn Ventilator Company/Ultra Quiet Zephyr, or an approved equal.

12. FAN SUPPORTING REQUIREMENTS

A. All supporting steel shall conform to ASTM Designation A-36.

B. Patch existing beam fireproofing where removed.

C. All nuts shall have lock washers.

D. The contractor shall verify and field measure existing conditions.

E. Refer to Contract Drawings for installation details.

13. VIBRATION ISOLATION

A. Provide isolation for equipment, piping and ducts and install in accordance with manufacturer's instructions.

B. Provide leveling devices and approved resilient restraining devices as required to limit equipment and piping motion in excess of 1/4 in.

C. Vibration isolators shall be AVNEC(Mason Industries), Inc., or an approved equal.

D. Ceiling-hung fans and equipment:

a. Provide spring hanger rod isolators. Steel compression spring and neoprene sound pad within a steel retainer box. Similar to Mason Industries, Inc. Type SLF, SLR, or PCHS.

b. One (1) in. minimum static deflection, ½ in. minimum reserve deflection, factory-preloaded to 75% of a rated load.

c. Provide supplemental steel as required where equipment or structure cannot support point loads.

E. Floor mounted equipment having internal isolation:

a. Provide 5/16 in. thick neoprene acoustical base pads of ribbed or waffle construction. Similar to Mason Industries Inc. Type W.

b. 50 psi maximum loading. Provide steel bearing plate to distribute load where required.

F. Floor-mounted equipment requiring external vibration isolation:

a. Provide built-in resilient vertical limit stops. Provide two layers of 1/4 in. neoprene base pad separated by 1/16 in. sheet steel. Tapped holes shall be in top plate for bolting to equipment. Isolators shall be capable of supporting equipment at a fixed elevation during isolation.

b. 1 in. minimum static deflection.

c. Corrosion resistant when exposed to weather.

d. Provide supplemental steel as required where equipment or structure cannot support point loads.

14. SELF-CONTAINED WATER COOLED AIR CONDITIONING EQUIPMENT

A. Furnish and install packaged ceiling/floor mounted air conditioning units manufactured by Liebert, Carrier, ClimateMaster, McQuay, Trane, Koldwave, ATS, BSC, Florida Heat Pump, Friedrich, Mammoth,or approved equal. The unit shall be designed for use with refrigerant R-22 only. The capacity and schedule of the units are to be as indicated on the Contract Drawings. The units shall be factory operated, tested and rated in accordance with ARI Standards.

B. The MEA number for the unit is _____.

C. AC condenser, condenser water piping, control valves, and all other equipment in the water cooling circuit must be designed and rated for a working pressure of _____ psig.

D. Direct expansion coils shall be constructed of copper tubes and aluminum fins. For enhanced temperature and dehumidification control, the coil shall be designed to provide two steps of cooling. The coil shall be provided with a stainless steel drain pan (primary).

E. The refrigeration system shall consist of a hermetic compressor, pressure safety switches, externally equalized expansion valve, and a refrigerant sight glass and a moisture indicator.

F. The fan shall be centrifugal type, selected to operate in the stable portion of its performance curve with the filters clean or dirty. The fan motor shall be 1750 RPM and mounted on an adjustable slide base.

G. All motors 1 hp and above shall be three phase, 460 volts.

H. The water regulating valve shall be two-way, refrigerant pressure actuated, positive shutoff type, as manufactured by Metrex, Model WCCW-3099-SE-2W Series, design working pressure up to 350 psig. For working pressure 350 psig. and higher, indicate the specific working pressure required.

I. Air filters shall be UL listed, Class 1 or Class 2, two in. thick pleated media, with a rated average dust spot efficiency of not less than 35 % based on ASHRAE 52-76 test method.

J. AC unit shall be interlocked with its associated condensate pump such that if the pump is not operating, the AC unit shall be locked out, or the AC units shall shutdown on a high-water condition in the auxiliary condensate drain pan. Refer to control wiring diagram on the electrical drawing.

K. In addition to those factory preset alarms, the unit shall provide overflow drain pan (auxiliary) with water alarm. The overflow drain pan requirements are as follows:

a. Make pan 3 in. larger than AC unit on each of the four (4) sides.

b. Make upstanding sides 1-1/2 in. with ½ in. hem turned down outside of pan.

c. Use U.S.No.16 galvanized steel with soldered corners for water tightness.

d. Use 1-1/4 in. drain and algaecide tablets to minimize clogging inside for condensate pan within AC unit.

e. Where raised floor applied, install pan prior to installing raised floor.

L. Units shall incorporate and activate audible and visual alarms in accordance with the following requirements:

a. Surface water sensing alarm system shall be made by Dorlen Products Inc. Water sensor shall be non-self contained water alert type, Model SS-R(T) or SS-1-R (T), with remote indicator Model R1-2(T) for up to 6 Water Alerts, or Model R1-2(AT) for up to 12 Water Alerts. Power supply Model PS-3 is recommended for Water Alerts.

b. Use alarm easily heard by personnel in nearby closed rooms.

c. Place a durable metal sign permanently affixed to alarm to read:

"When alarm sounds, call 435-4164 weekdays and weekends."

d. Unit shall shut down upon activation of alarm.

M. AC units, with total supply air capacity of 2000 cfm and above, shall be provided with a duct-mounted smoke detector, or an area smoke detector for non-ducted type AC installation. Those AC units shall shutdown upon activation of any smoke detector in the area served by the AC unit and have a smoke detection ability to activate the base building Class "E" alarm system through the tenant's smoke detection panel via Cerberus Pyrotronics TRI-60 Series Intelligent Initiating Devices Interface Modules. Smoke detectors are not required for AC units with capacity below 2000 cfm.

N. Attachments to existing steel deck shall be limited to loads of 500 lbs. Attachments shall be accomplished by drilled-in expansion shield type anchors located on the center line of the concrete filled ribs. Heavier loads shall be supported by supplementary structural steel connected to beams.

O. Monitoring & Control System and Sequence of Operation :
(To be completed by the Engineer)

P. Condensate pump, humidifier and reheat systems :
(To be completed by the Engineer)

15. AIR HANDLING UNITS (CHILLED WATER/REHEAT HOT WATER)

A. Furnish and install as shown on the plan air handling unit, manufactured by Carrier, Trane, McQuay, Bohn, or approved equal. It shall be four piped, complete unit with fan section, chilled water cooling coil, hot water heating coil, filter, motor, drain pan and all accessories as specified. Capacity shall be as shown in the schedule on the Contract Drawings.

B. Unit shall be constructed of a complete frame with removable panels. Fan housing shall be galvanized steel with a minimum US No. 18 gauge. Insulation for casing panels on unit shall be with one inch minimum thickness dual density fiberglass insulation with a density of not less than nominal 1.5 lb. per cubic ft. Fan shall be centrifugal, forward-curved (FC), backward-inclined (BI) or backward-inclined airfoil (AF), double width, double inlet, and shall be statically and dynamically balanced. Fan shall be tested in accordance with the strict requirements of ANSI/ASHRAE Standard 51 and ANSI/AMCA Standard 210. Fan performance data shall be as specified in the schedule. A complete fan performance curve shall be submitted for the Engineer's approval. Fan and motor shall be isolated by spring type isolators. Motor drive shall be variable inlet vans, variable pitch, or heavy-duty adjustable speed V-belt drive suitable for adjustments within 10% of specified RPM.

C. Motor shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motor shall be mounted inside the unit casing, on a slide base to permit adjustment of drive belt tension. All motors 1 hp and above shall be three phase, 460 volts.

D. Chilled water and Heating Coils shall be aluminum plate fins with belled collars and bonded to ½ in. minimum OD copper tubes with minimum 0.025 in. wall thickness by mechanical expansion. Coils shall have galvanized steel casings and steel headers with threaded connections. Chilled water coils shall be guaranteed for minimum 300 psig working pressure, and shall be tested with minimum hydrostatic test pressure of 400 psig. Heating coils working pressure shall be 150 psig. Coils shall be drainable and have nontrapping circuits. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standards 410, 430 or 440 depending on the type and sizes.

E. Air filters shall be UL listed, Class 1 or Class 2, two in. thick pleated media, with a rated average dust spot efficiency of not less than 35 % based on ASHRAE 52-76 test method.

F. Outdoor air and return air dampers shall be provided to modulate the volume of outside and return air including an air side economizer operation. Dampers for mixing boxes shall be rated low-leakage dampers, having a leakage rate not to exceed 5% of air quantity calculated at 2000 fpm velocity through damper and 4.0 in. wg. pressure difference. Damper blades shall be gasketed and perimeter sealing strips shall be provided.

G. AC unit shall be interlocked with its associated condensate pump such that if the pump is not operating, the AC unit shall be locked out, or the AC units shall shutdown on a high-water condition in the auxiliary condensate drain pan. Refer to control wiring diagram on the electrical drawing.

H. In addition to those factory preset alarms, overflow drain pan (auxiliary) with water alarm shall be provided. The overflow drain pan requirements are as follow:

a. Make pan 3 in. larger than AC unit on each of the four (4) sides.

b. Make upstanding sides 1-1/2 in. with ½ in. hem turned down outside of pan.

c. Use U.S.No.16 galvanized steel with soldered corners for water tightness.

d. Use 1-1/4 in. drain and algaecide tablets to minimize clogging for condensate pan within AC unit.

e. Where raised floor applied, install pan prior to installing raised floor.

I. AC units shall incorporate and activate audible and visual alarms in accordance with the following requirements:

a. Surface water sensing alarm system shall be made by Dorlen Products Inc. Water sensor shall be non-self contained water alert type, Model SS-R(T) or SS-1-R (T), with remote indicator Model R1-2(T) for up to 6 Water Alerts, or Model R1-2(AT) for up to 12 Water Alerts. Power supply Model PS-3 is recommended for Water Alerts.

b. Use alarm easily heard by personnel in nearby closed rooms.

c. Place a durable metal sign permanently affixed to alarm to read: "When alarm sounds, call 435-4164 weekdays and weekends."

d. Unit shall shut down upon activation of alarm.

J. AC units, with total supply air capacity of 2000 cfm and above, shall be provided with a duct-mounted smoke detector, or an area smoke detector for non-ducted type AC installation. Those AC units shall shutdown upon activation of any smoke detector in the area served by the AC unit and have a smoke detection ability to activate the base building Class "E" alarm system through the tenant's smoke detection panel via Cerberus Pyrotronics TRI-60 Series Intelligent Initiating Devices Interface Modules. Smoke detectors are not required for AC units with capacity below 2000 cfm.

K. Attachments to existing steel deck shall be limited to loads of 500 lbs. ~~Attachments~~ shall be ~~accomplished~~ by ~~drilled~~-in expansion shield type anchors located on the center line of the concrete filled ribs. Heavier loads shall be supported by supplementary structural steel connected to beams.

L. Monitoring & Control System and Sequence of Operation :
(To be completed by the Engineer)

M. Condensate pump: (To be completed by the Engineer)

16. RETURN AIR FANS

(To be furnished by the Engineer as required)

17. MOTORS AND MOTOR CONTROLLERS

A. General

Design and performance of components and methods specified herein shall comply with the applicable provisions of the Codes, Standards, and recommendations of the NYC Building Electric Code, ANSI, IEEE, NEMA, and NFPA.

B. Motor

a. All motors, with the exception of severe duty motors as defined below, shall be designed to operate continuously at 40° C ambient temperature with a service factor of 1.15, unless otherwise specified

in other Section. Severe duty motors shall have a service factor of 1.0 at 65° C ambient.

b. Fractional horsepower motors below 3/4 hp shall meet NEMA requirements for minimum torque and maximum current.

c. Motor 1 hp and larger shall be 460-volt, three-phase, 60 Hz, squirrel cage induction type. Motor below 1 hp may be 120 volt, single phase, 60 Hz, capacitor start, induction run or split phase type.

d. Use open dripproof type motors for general indoor applications. The motors shall have minimum Class "B" insulation.

e. Use totally enclosed, fan-cooled type motors for special indoor applications such as inside return air plenums, for inline direct-driven fans and when floor-mounted near hose down areas or for other applications as shown on the Contract Drawings. The motor shall have minimum Class "B" insulation.

f. Bearings for integral horsepower motors shall be antifriction, open type with grease fittings and shall have a minimum rated life of 125,000 hours for direct coupled motors and 25,000 hours for belt or chain driven loads. Bearings for fractional horsepower motors shall be permanently sealed ball type, suitable for continuous duty.

g. Provide solderless lugs of proper sizes at the ends of motor leads.

h. All motors shall be labeled by the manufacturer with an NEMA minimum efficiency marking standard in accordance with NEMA Standard MG-1-12.53b when tested in accordance with IEEE Standard 112.

I. Unless otherwise specified, motor shall be one of the following manufacturers:

General Electric Co.
Westinghouse Electric Corp.
Siemems-Allis Inc.
Reliance Electric Co.

C. Motor Controllers

a. All motor controllers shall be combination controllers suitable for wall mounting.

b. All controllers shall comply with the following:

1) Controllers for motors 1 hp and larger shall be combination, magnetic, full voltage across-the -line starting, with circuit breaker, designed for operation on 460 volt or 208 volt, 3 phase, 60 Hz service. Single speed controllers shall be provided with three overload relays, one in each phase.

a) When thermal overload devices are provided, they shall be ambient temperature compensated. The coil interrupting overload contacts shall be on the phase side of the coil.

b) Provide two additional spare auxiliary contacts in each controller.

c) Two-speed starters shall have six overload relays, one in each phase for the two speeds.

2) Controllers for motors less than 1 hp shall be of the toggle, switch, manual type with integral overload protection and pilot light in the cover, and shall be designed for 120 volt, single phase, 60 Hz service. Where interlocks or automatic controls are required, provide magnetic across-the-line combination starters.

3) All magnetic controllers subject to manual start shall have momentary contact start-stop pushbutton, pilot light and reset button built into the cover. All magnetic controllers requiring electrical interlocks or automatic control shall have " Hand-Off-Automatic " switch, pilot light, stop and reset buttons built into the cover, unless subject to cycling control, in which case the pilot light shall be omitted.

a) Hand position on " Hand-Off-Automatic " switches shall permit local starting of the shunting all automatic controls. "Hand" position shall not bypass safety controls.

b) Combination controllers shall be capable of being locked in the open position. All controllers shall have manual reset on the overload relay.

4) Where required to prevent simultaneous starting of motors, provide interlocked controllers with time delay devices.

5) All individually mounted motor controllers, installed indoors, shall be furnished in an NEMA Type 1 general purpose enclosure.

6) The minimum controller size for three-phase motors shall be NEMA ICS 2, size 1.

7) In addition to NFPA 70 requirements for safety disconnect switches, where controllers are not directly adjacent to the motors they control, or where a safety disconnect switch is not specified to be furnished with motor-driven equipment, a heavy-duty, unfused disconnect switch, arranged for being padlocked in the open position, and also capable of interrupting the motor locked rotor current, shall be furnished for installation within sight of the motor.

8) All controllers for 460 volt or 208 volt service shall have 460/120 volt or 208/120 volt, respectively fused transformers built-in in each controller housing to serve all control circuits within the controller. Each controller subject to electrical interlock and/or automatic control shall have the necessary auxiliary contacts to perform the required operations. One set of terminals shall be provided for each control circuit.

9) Where interposing relays are required, they shall be furnished in separate enclosures adjacent to the controllers.

10) Where controllers are interlocked, a separate disconnect switch shall be mounted adjacent to the lead controller in order to disconnect all control voltages to the controllers.

11) All parts subject to wear or arcing shall be renewable.

12) All electrical control devices shall be heavy-duty oil tight construction.

13) All motor controllers, disconnect devices and other control devices shall be labeled as to use and function, utilizing engraved plastic nameplates with white letters on black background. Inscriptions shall be as shown on the Contract Drawings.

14) Unless otherwise specified, motor shall be one of the following manufacturers:

Allen-Bradley Co.
Cutler-Hammer Inc.
General Electric Co.
Square D Company
Westinghouse Electric Corp.

18. PIPING AND ACCESSORIES

A. Complete with: pipe, fittings, valves, strainers, motorized valve operators, strainers, hangers, supports, guide, sleeves, and accessories.

B. Condenser water piping shall be black steel pipe, Schedule 40, Grade B standard weight, conforming to ASTM A53. Fittings for 3 in. and below shall be cast iron threaded, Class 250 in accordance with ANSI Standard B 16.4 for up to 250 psig of rated working pressure, or malleable iron threaded, Class 300 in accordance with ANSI B16.3 for over 250 psig of rated working pressure. Fittings for above 3 in. size shall be butt weld, steel, schedule 40 and in accordance with ANSI B 16.9.

C. Chilled water piping shall be black steel pipe, Schedule 40, Grade B, standard weight, conforming to ASTM A53. Fittings shall have a rated working pressure of 300 psig. Fittings for 3 in. and smaller shall be threaded malleable iron Class 300 in accordance with ANSI B 16.3. Fittings for above 3 in. size shall be butt weld, steel, schedule 40 and in accordance with ANSI B 16.9.

D. Reheat hot water piping shall be black steel pipe, Schedule 40, Grade B, standard weight, conforming to ASTM A53. Fittings shall have a rated working pressure of 150 psig. Fittings for 3 in. and smaller shall be threaded malleable iron Class 150 in accordance with ANSI B 16.3. Fittings for above 3 in. size shall be butt weld, steel, schedule 40 and in accordance with ANSI B 16.9.

E. Water piping connecting to the induction unit shall be copper ASTM B-88, soft (annealed) type L, and fittings shall be standard weight, wrought copper and solder type. All soldered joints shall be made with 95-5 Tin Antimony Solder having a melting point greater than 450° F.

F. Condensate drain piping shall be copper hard temper Type "L", conforming to ASTM B-88 with wrought copper solder joint, conforming to ANSI B16.18.

G. Low pressure steam and condensate piping shall be black steel pipe, Schedule 80, Grade B, extra-strong, conforming to ASTM A53. Fittings up to 2 in. shall be screwed malleable iron Class 150 in accordance with ANSI B 16.3 or cast iron threaded, Class 250 in accordance with ANSI Standard B 16.4.

H. Domestic cold water makeup piping for humidifier shall be type TP, threadless copper piping, conforming to ASTM B302, with bronze fittings and brazed joints conforming to ANSI B16.18. Type L copper piping is not permitted.

I. Install drain valves at all low points of piping and air vents at all high points.

J. Provide manual air vents line size air chamber with ½ in. globe valve at high points and where flow direction changes from horizontal to downward.

K. All piping connections to equipment shall be installed with union for easy removal. Unions for 3 in. or less shall be similar and equal to malleable iron with brass seats, Class 300, as manufactured by Stockham, Grinnel, or an approved equal.

L. All nipples 6 in. or less shall be extra heavy shoulder type. Close nipples shall not be used.

M. Welding elbows shall be a long radius pattern unless otherwise shown on the Contract Drawings.

N. Use Teflon tape on male threads of screwed pipe.

O. No wet tap is permitted.

P. Braided type flexible connector shall be Vibration Mounting and Control Inc. (VICO), Model MFP style NE or an approved equal.

Q. Where changes of size occur in horizontal piping, provide eccentric type reducing fittings to attain proper drainage and venting of pipeline.

R. Provide dielectric couplings at junctions of copper and steel or galvanized piping.

S. Provide expansion and contraction of piping systems.

T. Pitch water piping except as noted.

a. Up to 1 in. : 1 in. in 40 ft.

b. 1-1/2 in. and larger: 1 in. in 100 ft.

U All pressurized piping to be tested hydrostatically to 150 PSI or 150% of rated operating pressure. Test duration to be 2 hours with no pressure change ~~corrected~~ for ~~temperature~~ change. Repair or replace leaks or defects without additional cost.

V. Radiography of welding for steam piping over 15 psig. and gas pipe shall be performed by the Contractor at the discretion of the WTC Supervising Engineer. Minimum of 15% of welds of piping systems specified will be randomly selected for radiographic tests.

W. The Port Authority reserves the right to direct the Contractor not to isolate the newly-installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, as directed by the WTC Supervising Engineer.

X. Pipe Supports and Hangers

a. All supports and parts shall conform to the latest requirements of ANSI B 31.9 as applicable for pressure piping and MSS Standard Practice SP-58 SP-69.

b. Do not hang piping from other piping. In no case shall hangers are supported by means of vertical expansion bolts.

c. If removal of existing fireproofing is required for installation purposes, such removal shall be performed by the Contractor and shall be kept

to a minimum. The Contractor shall replace all removed fireproofing with new fireproofing to the satisfaction of the Engineer and at no additional cost to the Authority.

d. Support hangers from building steel framing with an approved type clamp insert. Provide any additional steel supports between existing framing members as may be required. No hangers shall be supported from metal deck floor. Welding to the building structure members will not be permitted unless approved by the Port Authority.

e. Pipe hangers' rods, inserts and clamps shall be that UL approved for their respective uses.

f. Unless otherwise specifically approved, hanger size and spacing shall be as follows:

STEEL PIPING

Pipe Sizes	Max. Hanger Spacing	Minimum Rod Sizes
½" to 1"	7 ft. o.c.	3/8"
1-1/4" to 2"	9 ft. o.c.	½"
2-1/2" to 4"	10 ft. o.c.	½"
5" to 6"	10 ft. o.c.	3/4"
8" & up	10 ft. o.c.	7/8"

COPPER TUBING

Pipe Sizes	Max. Hanger Spacing	Minimum Rod Sizes
½" to 1-1/4"	6 ft. o.c.	3/8"
1-1/2" to 2"	8 ft. o.c.	3/8"
2-1/2" to 3-1/2"	10 ft. o.c.	5/8"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8"	12 ft. o.c.	7/8"
10" and over	12 ft. o.c.	7/8"

The above hanger spacings apply to straight runs of pipe only. At points where valves, specialties or branch connections are located, additional hangers, or supports shall be used to properly support the load.

g. Hangers and supports shall be manufactured by Grinnell Corp, Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or an approved equal.

Z. Y-TYPE STRAINERS

a. Provide screwed ends to 2 in. and flanged 2-1/2 in. and larger with body as follows:

1) To 100 psig: 125 lb wsp class, cast iron.
2) 100 to 250 psig: 250 lb. wsp class, cast iron.
3) Over 250 psig: 300 lb wsp class, forged steel or cast steel.

b. Screens shall be 316 stainless steel.

c. Provide screwed with faced cap, straight thread and gasket, similar to Mueller Steam Specialty Muessco No. 11. Provide flanged with bolted cover similar to Muellar Steam Specialty Muessco No. 751 or No. 752.

AA. Provide two adhesive bands, one identifing the piping system type and the other indicating the direction of flow. The adhesive bands shall be installed where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system. Bands shall be in colors as indicated below and shall conform to ANSI A 13.1.

System Identify	Background	Letters & Arrow
Steam	Yellow	Black
Hot Water	Yellow	Black
Chilled Water	Green	Black
Condenser Water	Green	Black
Condensate	Yellow	Black

Adhesive bands shall be manufactured by W.H. Brandy Co."Quick-Label", or an approved equal.

19. VALVES

A. Provide valves as and where shown on the Contract Drawings. The system shall be supplied with valves in all branches, mains and risers, at pumps, tanks, reducing and control elements, radiation, heating and cooling surfaces and at apparatus; so located, arranged and operated as to give

complete control. Except where flanged valves are used, each connection to equipment shall incorporate an union on the equipment side of the valve.

B. **All valves shall be carefully selected to meet the pressure of working and testing (1-1/2 times the rated working pressure) requirements in that particular application in the zone where the valves are served.**

C. Provide tag on valves in the base building riser closet or ceiling take-off area indicating the tenant's name, "Supply" or "Return", and floor served. The tag shall be made of either metal or plexiglass, 3 in.x 6 in. size, with a green background and black lettering.

D. Provide drain and vent valves that are not shown on the Contract Drawings but are necessary for the proper operation of piping systems, as follows:

a. Provide one inch drain valves with threaded ends for hose connections at drain points, at main shutoff valves, low points of piping systems, bases of vertical risers, and at equipment.

b. Drain valves at all water piping low points, conforming to the gate valves specifications for the particular system.

c. Manual vent valves at high points of piping areas that are difficult to service, conforming to the globe valve specifications for the particular system.

E. Ball Valves

Shutoff valves for 3 in. & smaller sizes shall be ball valves, two piece, threaded ends, bronze body/brass body, furnished with seat & stem seals of reinforced Teflon or PTFE, similar to Stockham S-216, Crane Capri No. 9302, or an approved equal.

Provide lever for quarter turn operation; lever to indicate open or closed position.

When used as drain valves, provide with hose thread and brass cap with chain. Cap to be rated for full system pressure.

F. Combination Balancing & Shutoff Valves

Valve shall be the eccentric non-lubricated plug valve, with adjustable memory stop and pressure tap, as manufactured by DeZurik. Rated working pressure and hydrostatic testing pressure (one and one-half times of rated working pressure) must be specified.

a. For Working Pressure up to 175 psig:

1) Sizes 1 in. through 2-1/2 in., DeZurik Series 400, screwed, cast iron conforming to ANSI Class 125.

2) Sizes 3 in. and up, DeZurik Series 100, flanged, cast iron conforming to ANSI Class 125.

b. For Working Pressure From 200 psig through 450 psig:

1) Sizes 2 in. and under, DeZurik Series 100, Fig.128/WG/SP, screwed, carbon steel conforming to ANSI Class 300.

2) Sizes 2-1/2 in. and up, DeZurik Series 100, Fig.128 DFX001, flanged, carbon steel conforming to ANSI Class 300.

G. Condenser Water Regulating Valves

The water regulating valve shall be two-way, refrigerant pressure actuated, positive shutoff type, as manufactured by Metrex, Model WCCW-3099-SE-2W Series, design working pressure up to 350 psig. For working pressure 350 psig. and higher, indicate the specific working pressure required.

H. Gate Valves

a. Up to 3 in., bronze threaded ends, solid wedge, inside screw, rising stem, union bonnet, similar to Stockham Fig: B-120 for Class 150, B-132 for Class 200, or approved equal. Bronze body and trim with bronze, threaded ends for steel piping and sweated ends for copper piping.

b. Above 3 in., iron body, flanged ends, rising stem, bolted bonnet, solid wedge disc, OS&Y, similar to Stockham Fig: G-624 for Class 125, G-667 for Class 250, or approved equal. Iron body and flanged end for steel piping. Bronze body, bronze trim and sweated ends for copper piping.

I. Globe Valves

a. Up to 3 in., bronze threaded ends, solid wedge or plug type disc, inside screw, rising stem, union bonnet, similar to Stockham Fig: B-22T for Class 150, B-32 for Class 200, or an approved equal. Bronze body and trim with bronze, threaded ends for steel piping and sweated ends for copper piping

b. Above 3 in., flanged ends, renewable seat and disc, bolted bonnet, OS&Y, similar to Stockham Fig:G-512 for Class 125 (iron body),Stockham Fig: 15-GPFU-S/30-GPFU-S for Class 150/300 (cast steel), or an approved equal. Iron body and flanged end for steel piping. Bronze body, bronze trim and sweated ends for copper piping.

J. Check Valves

Swing type, bronze body & disc, threaded ends, threaded cap, regrinding, suitable for both horizontal and vertical lines with upward flow, similar to Stockham Fig. B-321 for Class 150, Fig. B-345 for Class 200 (up to 2 in.), Crane No. 137 for Class 150, Crane No. 36 for Class 200 (up to 3 in.), or an approved equal. Screwed end for steel piping and sweated end for copper piping.

20. THERMOMETERS

A. Thermometers for piping shall be of the " all angle " (universal), separate socket, industrial type with # 304 stainless steel extension neck wells.

B. The thermometer for condenser water system shall operate at 0-160° F range, and shall include a sufficient safety margin at either end.

C. Thermometer shall be as manufactured by Albert A Weiss, Weksler Instrument Co., Ashcroft, or an approved equal.

21. PRESSURE GAUGES

A. Pressure gauges shall be of the bourdon tube spring type with 4-1/2 dial sizes. Gauges shall have black aluminum cases with black numbers on white background. The gauge shall be as manufactured by Albert A. Weiss, Weksler Instrument Co., Ashcroft, or an approved equal.

B. The pressure range for the auxiliary cooling shall be 0 - 500 psi, and the Bourdon tube shall be bronze.

22. SLEEVES AND ESCUTCHEONS

A. Pipe penetrations through masonry/concrete walls or floors and framed partitions shall have a trim opening cut not greater than necessary for the installation of a sleeve secured therein. The space between the pipe and its sleeve shall not exceed one-half inch.

B. Sleeves shall be flush with the finished wall or partition surface.

C. Annular spaces between piping and sleeves or core drilled floor openings shall be packed with mineral wool and sealed to retain the fire integrity of the walls, partitions, and floors with a non-hardening compound similar to Duxseal as manufactured by the J.M. Clipper Corp.

D. Sleeves for piping through masonry wall shall be Schedule 40, standard galvanized steel pipe; in framed partitions shall be 20 gauge sheet metal. The space between the pipe and its sleeve shall not exceed one-half inch.

The sleeve shall be flush with the finished wall surfaces.

E. Piping in exposed areas, passing through walls, floors, or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

23. HVAC INSULATION

A. General

a. Design and performance of components and methods specified herein shall comply with the applicable provisions of the Codes, Standards, and recommendations of the entities listed below:

New York State Energy Conservation Construction Code
New York City Building Code
American Society for Testing and Materials (ASTM)
National Fire Protection Association (NFPA)
Underwriters Laboratories Inc. (UL)

b. Insulation shall be applied to piping, duct and equipment of materials as specified herein and for applicable systems of this project .

c. All insulation, including jackets or facings, adhesives, mastics, cements, tapes and glass cloth for fittings shall have composite fire and smoke hazard ratings as tested by ASTM E 84, NFPA 225, and UL 723 procedures, not exceeding a "Flame Spread" of 25 and "Smoke Developed" of 50.

d. Note that equipment casings which are internally and acoustically insulated need not be insulated at the exterior surface.

e. Where internal duct insulation is required, the exterior duct insulation may be omitted, provided that the equivalent "R" factor for the internal duct insulation is the same as the external duct insulation requirements.

f. Condenser water piping, except system 10 glycol cooling, does not require the insulation. Glycol piping needs to be insulated.

g. Valves, fittings, strainers, and other piping appurtenances shall be insulated to match those of the systems to which they are connected.

h. All insulation and exterior jackets that are damaged shall be replaced with new material as specified, to the satisfaction of the Engineer.

I. Insulation materials shall be products of one of the following manufacturers :

Manville Corp.
Certain - Teed Corp./Insulation Group
Owens - Corning Fiberglass Corp.
Knauf Fiber Glass

B. Duct Insulation

a. In 1 WTC, those 17 in. x 8 in. supply ducts for interior air systems that are parallel with the east and west exposures must be insulated. In 2 WTC, those 17 in. x 8 in. supply ducts for interior air systems that are parallel with north and south exposures must be also insulated.

b. HVAC supply, return, transfer, and auxiliary ventilation air ducts concealed in hung ceiling, shafts and furred spaces shall be insulated with one in. thick, minimum one lb density, flexible blanket fiberglass, maximum 0.28 K-factor at 75° F mean temperature with factory applied foil-skrim-kraft (FSK) facing similar to Manville Microlite.

Wrap insulation tightly on duct with all transverse joints butted and longitudinal joints overlapped a minimum of two inches.

c. HVAC supply, return, transfer, outdoor air supply ducts and plenums exposed in mechanical equipment rooms, crawl spaces, all unconditioned areas, and outdoors shall be insulated with 1-1/2 in. thick rigid fiberglass board , not be less than six lbs. per cubic foot density, maximum 0.22 K factor at 75° F mean temperature with factory applied all purpose white facing for indoors. The insulation board shall be 2 in. thick for outdoor application. The insulation shall be Manville "817 SPIN-GLAS" with AP white facing, or an approved equal.

Impale insulation over stick clips or pins welded to duct with protruding ends of pins cut off flush, after the stick clips have been applied. Spacing of pins, to hold insulation firmly in place, shall be a minimum of one pin per sq.ft. Seal all joints and penetrations with a 3 in. wide strip of the same material, applied with approved adhesive to both side. For finishing, apply a tack coat of approved adhesive on all corners. Embed reinforcing mesh into wet adhesive and smooth out to eliminate wrinkles. Overlap all reinforcing mesh seams a minimum of 2 in. Apply finish coat of approved mastic to entire reinforcing mesh fabric. Weatherproofing of all outdoor ducts by using one coat of Manville "INSULKOTE PRIMER", one in. galvanized steel wire mesh, and two successive 1/8 in. thick coats of Manville "INSULKOTE ET" is required.

d. Kitchen exhaust duct, boiler breeching, and kitchen exhaust fan shall be insulated with a minimum insulation cover of 2 in. of magnesium or calcium silicate block. Insulation shall be securely banded in place with tightly butted joints, staggered and secured with 12 gauge annealed stainless steel wire, 12 in. on centers. Calcium silicate block insulation shall conform with ASTM C 533, Type 1, and shall be Manville " THERMO-12", or an approved equal.

e. Casing for built-up central station HV and HVAC units shall be insulated with 2 in. thick fiberglass duct liner with a neoprene coating. Insulation shall have a density of 3 lbs. per cubic foot with a thermal conductivity K = 0.24 at 75° F mean temperature and suitable for air velocities up to 5000 fpm. Insulation shall be Manville "LINACOUSTIC", or approved equal. Insulation shall be fasten to

casing interior with mechanical fasteners spaced 12 in. on centers. All mechanical fasteners shall be flush with the foraged liner surface, and coated.

C. Pipe Insulation

a. Insulate all piping, fittings and valves in accordance with insulation schedule except as otherwise noted.

PIPING INSULATION MINIMUM THICKNESS (IN.)

Piping System	Fluid Temp. Range ,°F	Pipe Sizes (NPS)			
		Run-Out* to 2"	Up to 2"	2-1/2" to 4"	Over 4"
Heating Hot Water	Up to 250 F	1.0"	1.5"	2.0"	2.5"
Chilled Water, Make-up, Domestic Water Condensate Drain	40 to 60 F	1.0"	1.0"	1.0"	1.0"
Refrigerant and Chilled Water	Below 40 F	1.0"	1.5"	1.5"	1.5"

b. Insulation shall be minimum 6 lb density molded fiberglass insulation, maximum 0.23 K-Factor at 75° F mean temperature with factory-applied all purpose (AP) facing or aluminum jacket.

c. Fittings, valves and flanges shall also be insulated with compressed fiberglass and wired in place with 18 gauge galvanized steel wire. Pre-molded PVC insulation covers for fittings are not allowed.

d. Before applying insulation, all pressure and leak tests shall be completed and approved.

e. All insulation shall be butted firmly together. Provide 2 in. lamp strips at all seams secured with adhesive. Use vapor barrier tape and vaporseal adhesive where required. Staples are not permitted.

f. All insulation and vapor barriers shall be continuous passing through sleeves, hangers, etc., or other openings. Provide saddles or shields for protection.

24. TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS

A. Work in this Section includes the providing of labor, materials, equipment, and services necessary for complete testing, adjusting, and balancing of all HVAC systems in accordance with the Contract Documents, procedures and standards described in the latest manuals as published by American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) and The Sheet Metal and Air Conditioning Contractor's National Association, Inc.(SMACNA) for the following:

   a. All of the air systems.

   b. All supplementary tenant air conditioning units.

   c. Hydronic systems.

   d. Perimeter induction units.

   e. All tenant proprietary HVAC systems using the base building chilled water, reheat hot water, ASOA outdoor air and spill air.

   f. All return, transfer and exhaust air systems.

B. The testing shall be performed in the presence of a WTC Construction Supervising Engineer.

C. All air terminal devices shall be balanced to within five percent of their design requirements.

D. All fans and air handling units shall be balanced to within ten percent of their design capacities.

E. The performance of induction units shall be adjusted and balanced as indicated on the drawings in accordance with the instructions provided by the Carrier Air Conditioning Company.

F. In Concourse and Plaza levels, all tenant proprietary HVAC systems shall be tested and balanced in accordance to the air balance schedule shown on the drawing to include normal, day, night, summer, winter, air economizer cycle and smoke purge cycle.

G. For restaurant tenants, each kitchen exhaust hood performance data and total area (kitchen/dining) air balance summary data shall be included in the balance report.

H. Auxiliary ventilation air system: Record the static pressure available at the riser taper before final duct connection is made.

I. For duct testing, make pitot tube traverse of main supply ducts either from the base building supply shafts or at fans, and obtain design air quantities.

J. The temperature conditions, both D.B. and W.B. and sound levels shall be read and recorded.

K. After testing and balancing work is complete, the Contractor shall replace a new set of air filters.

L. All openings in ducts, plenums, and other similar items, necessary to the balance work, shall be repaired by the Contractor in a suitable manner. All patching must be suitable to the service of the systems such as maintaining vapor seals in cold ducts and other similar services.

M. Upon completion of testing and balancing of the HVAC systems, three (3) copies of the Balancing Report must be submitted to the WTC Construction Supervising Engineer, and one (1) copy to the TAA Project Manager in WTC Tenant Services Division.

25. AUTOMATIC CONTROLS

A. Contractor shall furnish and install a complete and functional automatic control and interlocking control system outlined herein. Controls, except for induction units, shall be electric/electronic type.

B. Thermostat for induction units shall be pneumatic, proportional, 2-pipe controller type with a remote, liquid-filled, bulb thermal element, as manufactured by Honeywell, Model LP916B. The thermal element must be installed in the return air path of the induction unit that is controlled.

C. For all standby AC units using condenser water systems, a positive interlock (electrical relay & contacts) must be provided to insure that only one machine can operate at a time.

D. Duct-mounted or area smoke detectors shall be installed for AC units as shown on Contract Drawings. When smoke conditions exist, any one of the duct-mounted smoke detectors or area smoke detectors shall sound an alarm and stop respective fans serving area of alarm. Smoke detectors shall be in accordance with the electrical specifications.

E. For tenant owned pneumatic system: Copper piping shall be hard temper type L, conforming ASTM B-88 with wrought copper solder joint, conforming ANSI B16.18. Copper piping must be used in all vertical risers. For nonmetallic tubing, PVC type is not permitted. Non PVC type may be used for the final connection to the controlled devices.

F. Unless otherwise noted, install wall mounted thermostats and humidistats 4'-6" above the floor measured to the center line of the instrument.

G. Unless stated otherwise, control temperatures within plus or minimum 2 deg. F and humidity within plus or minus 5% of the set point.

H. (To be furnished by the Engineer as required.)

26. SMOKE PURGE OPERATION

A. The following control sequence for smoke purge system operation must be provided for those tenant proprietary HVAC systems using the Port Authority base building ASOA outdoor air and spill air systems :

a. Upon activation of smoke detector :

1) Shut down supply air fan _____, return air fan _____, and toilet exhaust fan_____.

2) Fully close tempered air (outdoor air), spill air, return air and toilet exhaust air dampers.

3) Sent alarm signal to B-1 level WTC Operation Control Station.

b. A standard 1620 Fireman's keyed switch identified as "Smoke Purge System", located in front of Concourse store front (public side), shall activate the smoke purge switch which:

1) Open the spill air damper.

2) Start the return/exhaust air fan.

3) Keep the supply air fan and toilet exhaust air fan off.

4) Keep tempered air, return air and toilet exhaust air damper closed.

FIRE PROTECTION DESIGN GUIDELINES

A. WET-PIPE SPRINKLER SYSTEMS

1. General

   a. All tenant spaces shall be sprinklered. Except for a few areas, most tenant floors in The World Trade Center are provided with wet-pipe sprinkler systems New tenants normally require a new sprinkler system. For renovations of existing spaces, modifications to the existing system are normally needed to comply with any new partition configuration.

   b. Sprinkler work shall be designed to comply with the requirements of the New York City Building Code, NFPA 13 and the PA/WTD. In areas requiring specialized sprinkler systems, additional applicable standards as referenced in NFPA 13 shall be used for design, including but not limited to the following: NFPA 15,16,231 and 231C.

   c. The system shall be a hydraulically designed. A pipe schedule design may be used only for minor renovation work that doesn't change the number of heads, and only relocates a few existing sprinkler heads.

   d. The hydraulic analysis of an office space shall be designed for a light hazard occupancy at minimum of 0.1 gpm per sq. ft. of water density. The area of application for most hydraulic demand is 1,500 sq. ft. The protection area per sprinkler shall not exceed 225 sq. ft.

   e. Commercial spaces, storage areas, and all spaces other than light hazard occupancy shall comply with water densities and area of application requirements described in NFPA 13. The protection area per sprinkler shall not exceed 130 sq. ft.

   f. For restaurant service areas: Ordinary Hazard Group 1, 0.16 gpm per sq.ft. water density, 1,500 sq.ft. of hydraulic demand area, maximum 130 sq.ft. per head of protection area.

   g. For restaurant seating areas: Light Hazard Group, 0.10 gpm per sq.ft. of water density, 1,500 sq.ft. of hydraulic demand area, maximum 225 sq.ft. per head of protection area.

   h. Sprinkler main in core corridors of 1 WTC and 2 WTC shall be 2-1/2 in. diameter.

i. Large drop sprinklers and Early Suppression Fast Response (ESFR) sprinklers are not permitted for use in the World Trade Center.

j. All spaces shall be sprinklered except electric closets, telephone closets and public toilet rooms. Sprinkler heads are not required in telephone and electric closets if they meet the following requirements:

1) The closet is not intend for storage use.

2) The closet wall is constructed with minimum 2 hour-rated materials.

3) A smoke detector is installed inside the closet and is connected to the base building fire alarm system.

k. Refer to Attachment FP-5 for a detail of location of pipe in suspended ceiling. Refer to ~~Attachments~~ FP-6 & 7 ~~for details of typical piping~~ connection to sprinklers. Fire protection symbol list, pipe hanger installation, and detail of pipe through rated wall and are shown in Attachments FP-1, 8 and HVAC-2. They shall be shown on drawings where applicable.

l. For tenants with internal staircase: Provide smoke curtains (dropped soffits) and the water curtain around the stair opening. The water curtain shall consist of closed sprinkler heads spaced 6'-0" on center, 12 in. from the opening.

m. Concourse Tenants - All openings between the main Concourse public corridors and tenant spaces be protected with a water curtain. The water curtain shall consist of closed sprinkler heads spaced 6'-0" on center, 12 in. from the opening on the tenant's side.

n. Complete sprinkler construction drawings and specifications including hydraulic calculation design criteria shall be submitted to the WTD Tenant Service Division with the Tenant Alteration Application for each new tenant space or alteration.

o. Refer to "Tenant Construction Review Manual", by Engineering Quality Assurance Division of Port Authority Engineering Department, Section 12 for other representative details that may be required.

p. Refer to the Part II, " Fire Protection Guide Specifications for Tenant Alteration Design", for complete details of wet-pipe sprinkler and fire standpipe system specifications. Tenant's consultant shall use the Guide Specifications as an aid in preparing his own specification.

2. Risers

a. In 1 and 2 WTC there are three risers with each riser serving different groups of floors. Riser A feeds floors 99 through 110, Riser B feeds floors 32 through 98, Riser C feeds floors 1 through 31. The riser serving individual floor is located in the janitors' closets on each floor. A 10,000 gallon tank located on the 110th floor of each tower feeds risers A and B, and is automatically refilled by the domestic water system. A 5,000 gallon combination fire standpipe and sprinkler tank, located on the 42nd floor of each tower, feeds riser C via cross connections on the B-1 level (elev. 294'), and is refilled by the domestic water system.

On each floor, there is a floor control valve assembly consisting of either a manual operated gate valve (OS & Y type) or a combination pressure reducing and shut-off valve, with tamper switch, water flow alarm, pressure gauge, inspector's test valve, and a drain valve. Refer to Attachment FP-2 for a schedule of floor control valve assemblies, broken done by towers and floors.

The existing combination pressure reducing and shut-off valves, manufactured by Potter- Roemer Inc., Model PRV-400-2.5-REG-U-MATIC or Fig. 4036, are set at a locked outlet pressure (at no flow) of 125 psig. A graph of pressure loss through both combination PRV/Shut-Off valve is shown in Attachments FP-3 and FP-4, respectively. The available residual pressure shall equal or exceed the pressure required to deliver the total calculated quantity of water. Refer to base building Contract WTC-749.00, Drawings SP-22 (for Tower A), SP-23 (for Tower B), and Contract WTC-521.00, Drawing ASP-7 (for Tower B) for a complete riser diagram, riser size and static pressure on each tower floor.

b. The remainder of the World Trade Center Complex, including the Subgrade, Concourse, 4 and 5 WTC is served by a separate system consisting of two 8 in. diameter main loops: one on the B1 level (elev. 294') and the other on the Concourse level (elev. 310'). Risers down to the Subgrade are connected to the loop on level B1. Risers serving the Concourse level, 4 and 5 WTC are connected to the loop

on the Concourse level. Sprinkler booster pumps supply city water to the loops. Concourse water supply is 130 psig. static and 120 psig. residual at 1500 gpm flowing.

c. In 4 WTC, Riser A located in Stairs C & D serves only the second floor (plaza level.) Riser B, located in Stairway E, serves the north zone of Floors 1 through 9. Riser C, located in Stairways A and B, serves the southeast zone of Floors 1 through 9.

d. In 5 WTC, sprinkler risers A and E go to the second floor. Sprinkler riser B (west zone - stairwells A and B), riser C (east zone - janitors' closets), and D (south zone - stairwells E and F), serve up to the 9th floor.

e. In both 4 and 5 WTC each zone of each floor is equipped with a floor control valve assembly consisting of a manual operated gate valve (OS & Y type), tamper switch, water flow alarm, pressure gauge, inspector's test valve, and drain valve.

B. PREACTION SYSTEMS

1. Only a single zone detecting system shall be used. Actuation of the fire detection system opens a Preaction valve (deluge valve) that permits water to flow into the sprinkler pipe system. Each sprinkler head operates when its fusible link melts.

2. Sprinkler pipe sizing shall be hydraulically calculated. Hydraulic analysis of light hazard occupancy shall be based upon a minimum of 0.1 gpm per sq. ft. of water density with an area of application of 1,500 sq. ft. Areas requiring ordinary hazard occupancy coverage shall be provided with a minimum of 0.16 gpm per sq. ft. of water density with an area of application of 1,500 sq. ft.

3. A drainage system will be designed for the Preaction system.

4. Preaction system control valve assemblies for all floors shall be installed inside the tenant space. Refer to Attachment FP-9 for details.

5. When wet-pipe sprinkler systems are not provided in computer rooms, a Preaction system may be required to protect the areas above the raised floor. As an alternative, a total flooding, clean agent, fire extinguishing system with an approved Halon replacement gas can be designed. Refer to Section D for details.

6. Areas under raised floors where wiring is installed in raceways and combustibles are limited only require smoke detector protection. If the amount of combustibles is extensive and/or the cabling is not in raceways, these area shall be protected by a carbon dioxide or an approved total flooding, clean agent system.

C. FIRE STANDPIPE SYSTEMS

1. In 1 WTC and 2 WTC, three fire standpipe risers supply water to the hose stations on Floors 1 through 110. Risers FS-F1, FS-F2 and FS-F3 are located in Stairways B (Stairway 3), C (Stairway 2) and A (Stairway 1), respectively. Riser FS-F1 supplies water to all hose racks in Stairway B and also to all auxiliary hose cabinets in corridors and tenant areas.

2. The 4 WTC has five fire standpipe risers (FSP 1 through FSP 5) which supply water to the hose stations on Floors 2 through 9. The hose stations are located in stairways and in one area near passenger elevator bank.

3. The 5 WTC has eight fire standpipe risers (F1 through F8) which supply water to the hose stations on Floors 2 through 9 and also to a roof manifold. Hose stations are located in stairways and in other floor areas.

4. Show on the construction drawings the new or existing fire standpipe hose racks, hose cabinets and standpipe risers on the floor which provide the coverage for the tenant space. Auxiliary hose stations are required when any space/room cannot be reached from any existing hose stations using a 20 foot stream from a nozzle attached to a 125 foot hose.

5. In 1 WTC and 2 WTC, tenant auxiliary standpipe system shall only be connected to the existing capped outlets provided at fire standpipe riser FS-F1 located in Stairway B. In 4 WTC, tenant auxiliary standpipe system shall only be connected to the existing capped outlets provided at fire standpipe risers FSP-1, FSP-2, FSP-3, FSP-4, and FSP-5 (Floors 2,3,4 & 5 only). In 5 WTC, tenant auxiliary standpipe system shall only be connected to the existing capped outlets provided at fire standpipe risers F1 (Floors 6 & 7 only), F2, F3, F4 and F5 (Floors 2 & 3 only). A new full sized future capped outlet shall be provided at the tie-in location when tie-in to the existing capped outlet is required. Tenant auxiliary hose station shall be designed in accordance with Attachment FP-10.

6. Provide Potter-Roemer Model # PR- 2766, 2-1/2 in. brass adjustable pressure reducing valve (PRV) where normal hydrostatic pressure at 1-1/2 in. hose station exceeds 85 psig. A listing of all floor hydrostatic pressures and setting number required by the Potter-Roemer are presented in Attachment FP-12A for 1 WTC and FP-12B for 2 WTC. In 4 WTC and 5 WTC, PRV (setting 8) is required from B-1 up to Third Floor (Mezzanine Level).

7. Attachment FP-11 lists fire standpipe zone pressure, pipe and fittings requirements for 1,2,4 and 5 WTC.

D. CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

1. New installation of gas-fired extinguishing systems are permitted in the World Trade Center when these systems are approved by New York City.

2. Inspection, testing, and maintenance of automatic gas systems shall be performed by competent contractors and recorded results shall be submitted to the World Trade Center Fire Safety Coordinator.

3. Inspection, testing, and maintenance shall conform to the recommended routines outlined in NFPA 2001, any New York City Building Code reference, New York City Fire Department Directive reference, and the manufacturer's maintenance and service manuals.

4. A separate duct purge system (minimum of 6 air changes per hour of exhaust rate) is required to exhaust the discharging gas to the outdoor. The exhaust duct shall be arranged so no gas is allowed to infiltrate into other spaces.

5. Complete Contract Drawings, specification, and testing procedures, shall be submitted to the Port Authority for review with the Tenant Alteration Application.

E. HALON FIRE EXTINGUISHING SYSTEMS

1. New Halon fire extinguishing systems shall not be installed in the World Trade Center.

2. When any existing Halon system is abandoned, carefully remove the Halon storage containers so that Halon will not be discharged. Containers shall be returned for recycling or recovery of the agent when no longer needed, to comply with NFPA 12A-1992 Edition, Section 2-1.4.2.

3. If the tenant decides to keep the existing Halon fire protection system, then the following tasks shall be performed:

   a. Inspection, testing, and maintenance of automatic Halon systems shall be performed by competent contractors and the recorded results shall be submitted to the World Trade Center Fire Safety Coordinator.

   b. Inspection, testing, and maintenance shall conform to the recommended routines outlined in the NFPA 12A, New York City Fire Department Directive, dated October 22, 1990, and the manufacturer's maintenance and service manuals.

   c. A complete testing specification shall be submitted to the Port Authority of for review.

F. PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers shall be provided for all spaces. The design shall follow the New York City Fire Department Directive, Rules for Portable Fire Appliances, dated September 17, 1980 and Section 27-4009 of New York City Fire Prevention Code, dated July 1, 1988.

FIRE PROTECTION SPECIFICATIONS

This specification provides the tenant's consultant engineer with WTC requirements for the fire protection systems normally required by WTC tenants. The substance of this information must appear in the construction documents as required

1. GENERAL

A. The Contract Drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements. The Contractor shall examine the site of the proposed work to determine the existing conditions that may affect his work.

B. The construction documents shall call for finished work, tested and ready for operation. All materials shall be new and of first-quality.

C. All materials, work, incidental accessories or other details not shown but necessary to make the work complete and ready for operation, even if not shown or specified in the construction documents, shall be provided by the Contractor at no additional cost.

D. Upon review of sprinkler drawings prior to submitting his proposal, the Contractor shall inform Architect and/or Engineer of any discrepancies or request clarification in writing, if necessary, concerning the intent of the plans and specifications to provide a complete sprinkler installation. Later claims will not be recognized for extra labor, equipment or materials should such procedures not be followed.

E. Existing pipes, fixtures, utilities, etc. that are damaged during construction period, whether or not due to the Contractor's negligence, shall be repaired or replaced by the Contractor and left in a condition satisfactory to the PA/WTC Construction Supervising Engineer.

F. All fire protection work shall be free from defects in workmanship and materials for a period of one (1) year from date of final acceptance and shall meet all local and state codes. All defects, which develop or are discovered within this period, shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost.

G Any existing piping disturbed in making connections shall be returned to perfect conditions.

H. The Contractor shall request fire standpipe riser and sprinkler shutdowns 48 hours in advance by notifying the PA/WTC Construction Inspector who will coordinate the shutdown. The Contractor shall insure that drainage will be discharged to an approved location or receptacle without causing damage to other work and property.

I. All unused piping, fire hose cabinets, hangers, and supports shall be completely removed back to the core riser closet or the nearest active cross main, and be capped and sealed watertight. Any resulting openings through existing partitions shall be promptly patched, sealed and firestopped to maintain the partition's fire rating.

J. The design, installation, and performance, with the approvals, and listing requirements for all components, methods of design, and documents must be made to comply with the applicable provisions of the codes, and standards of the following entities:

PANYNJ	Port Authority of New York and New Jersey
NYCBC	New York City Building Code
NYCFC	New York City Fire Code
NFPA	National Fire Protection Association
FM	Factory Mutual Research Corporation
ASTM	American Society for Testing Materials
ANSI	American National Standards Institute
UL	Underwriters Laboratories, Inc.

2. SCOPE OF WORK

(To be finished by tenant's consultant)

3. SUBMITTALS

A. Submit the following for engineer's review and approval:

a. Detailed shop drawings, including the hydraulic calculations, when required. The drawings shall include WTC building column numbers, room designations, all partitions, lights, ceiling construction, access doors, sprinkler heads, piping, hanger locations, vertical and horizontal piping offsets, pipe elevations, control valves, and the water supply information. The drawings shall also note and show the specific standards, codes, and sections which apply, the design hydraulic areas, the design criteria, and available water supply test results.

b. Electrical wiring diagrams, when required.

c. Catalog cuts for the following:
-Sprinkler heads
-Fittings and flanges
-Valves
-Tamper switches and alarm devices
-Hangers and supports
-Sleeves and escutcheons
-Valve tags and pipe identification bands
-Pressure gauges
-Other specialty item specified in this Section

d. Piping material and schedule for each piping system

e. Valve charts and schedules

f. List of access doors

g. Field test results.

B. The approval and submission of all As-Built drawings is the responsibility of the tenant's consultant. One (1) reproducible Mylar copy and one (1) CAD diskette (3-1/2", 1.44 MB floppy) of the approved as-built drawings, must be submitted to the TAA Project Manager in WTC Tenant Services Division for record purposes. The Mylar reproducibles must be stamped "As Built" and signed by the tenant's consultant and the Contractor.

C. Require the contractor to submit operation and maintenance manuals, including replacement and spare parts lists for the fire protection systems.

4. PRODUCTS

A. Pipe and Fittings

a. All wet system sprinkler piping shall be standard weight, Schedule 40 black steel pipe, conforming to ASTM A795/A53 with threaded cast iron fittings, Class 125, or malleable iron fittings, Class 150. Schedule 10 pipes, grooved piping, and mechanical grooved fittings are not permitted. Victaulic fittings are not permitted to be used for size 3 in. and under unless otherwise approved.

b. Nipples shall be extra-heavy, shoulder type, and of the same material as the pipe. Close nipples, adjustable sprinkler nipples, and bushings shall not be used.

c. Unless otherwise shown on the Contract Drawings, piping connections to equipment shall be made up with unions for piping 2 in. and smaller, and shall be flanged for piping 2-1/2 in. and larger.

d. Gaskets for flanges shall be 1/16 in. thick (after compression), rubber or neoprene, full-faced with punched bolt holes.

e. Galvanized pipe, Schedule 40, conforming to ASTM A795/A53 with galvanized threaded fittings may be used for Preaction systems.

f. Fire standpipe piping for Zones 1,2 and 3 (76th through 110th Floors in 1 WTC and 2 WTC) shall be standard weight, Schedule 40 black steel pipe, conforming to ASTM A795/A53 with threaded cast iron fittings, Class 250, 350 # W.W.P. Fire standpipe piping for Zones 4,5 and 6 shall be extra strong, schedule 80 black steel pipe, conforming to ASTM A53. The fittings for Zone 4 (75th through 58th Floors in 1 WTC and 2 WTC) shall be threaded, malleable iron fittings, Class 300, 500 # W.W.P. The fittings for Zone 5 (57th through 20th Floors in 1 WTC and 2 WTC) shall be threaded, malleable iron fittings, Class 300, 800 # W.W.P. The fittings for Zone 6 (19th through B-6 level in 1,2,4 and 5 WTC and Concourse Area) shall be threaded, malleable iron fittings, Class 300, 1000 # W.W.P. For Zones 4,5 and 6, Victaulic style 77 couplings and grooved end fittings may be used for sizes 4 in. and larger where threaded fittings are not available.

B. Valves for Wet-Pipe Sprinkler Systems: Specify that all valves of the same type must be the product of one manufacturer.

a. Control Valves (where required)

1) Valves shall be OS&Y, solid wedge gate valves with rising stem and wheel handles, rated for 175 psi w.w.p. Valves shall have gland followers in stuffing box and shall be repackable while open and under pressure.

2) Each valve shall be stamped with the manufacturer's name and working pressure of the valve.

3) Valves, 2 in. and smaller, shall be threaded, bronze body.

4) Valves, 2 ½ in. and larger, shall be flanged, iron body. Provide valved by-pass for valves 6 in. and larger.

5) Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valves & Fittings, or an approved equal.

b. Tamper Switches (where required)

1) Install tamper switches in accordance with manufacturers' recommendations.

2) Tamper switches shall monitor the control valves to detect and indicate when a valve has been closed.

3) Unless otherwise shown on the Contract Drawings, tamper switches shall be completely factory assembled and wired, and shall be mounted on the control valve. The valve stem shall be prepared as required to accept the actuating roller rod.

4) The wiring to the control circuit shall be specified in the electrical specifications.

5) Tamper switches shall be manufactured by Potter Electrical Signal Co., Model OSYS-U-1 or U-2, or an approved equal by Acme Fire Alarm Co. Inc., or Fire Control Instruments Inc.

d. Drain and Test Valves

1) Valves shall be threaded, bronze, angle or globe type, with a composition disc, 175 psi w.w.p.

2) At system low points where the drain piping does not extend to a drain receptacle, provide a threaded hose and adapter at the valve outlet.

3) Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valves & Fittings, or an approved equal.

e. Check Valves (where required)

1) Check valves shall be swing type with renewable composition disc, bronze seat ring, and bolted cover.

2) Valves, 2 in. and smaller, shall be threaded, bronze, 175 psi w.w.p.

3) Valves, 2-1/2 in. and larger, shall be flanged, iron body, 175 psi w.w.p.

4) Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valve & Fittings, or an approved equal.

f. Sprinkler System Automatic Valves (where required)

1) Size automatic valves to be at least as large as the system riser and must be designed to meet the system demand and friction loss limitations in hydraulic design calculations. Automatic valves shall be manufactured by Reliable Automatic Sprinkler Co. Inc., Star Sprinkler Corp., Viking Corp., or an approved equal.

2) Wet-Pipe Alarm Valves

a) Alarm check valves shall be complete with all trimming including, but not limited to, retard chamber, water-motor gong, piping, fittings, an electric alarm switch, drip cups, valves, pressure gauges, sight glass, etc.

b) Alarm valves shall be Reliable "Model E" with "Model E-1" trimmings, or an approved equal.

C. Valves for Preaction Sprinkler System

a. Main control valves with tamper switch shall be OS&Y, solid wedge disc with rising stem, flanged ends, rated for 175 psi w.w.p. It shall be UL listed, FM and New York City approved, Stockham Model G-634, or an approved equal. The valve shall be secured in open position with tamper switch wired to a tenant control panel.

b. Deluge valves shall be a hydraulically operated differential diaphragm type, actuated by manual and electric detectors. Valves shall have the trim for electric actuation with a solenoid valve. Valves shall be Reliable Automatic Sprinkler Co. Model A valve and trim for size 2-1/2 in. and Model " BX " with external reset for size 4 in.

c. Check valve shall be swing type, flanged ends, rated for 175 psi w.w.p. It shall be UL listed, FM and New York City approved, Stockham Model G-939, or an approved equal.

D. Automatic Air Maintenance Device shall be self-contained supervisory air supply system, Reliable Automatic Sprinkler Co. Model B-1, with Model A air compressor. This device is intended for wall mounting and contains an integral alarm horn.

E. Alarm Actuating Devices (where required)

a. All water flow signal devices shall be the pressure activated type provided with the sprinkler system automatic valve. Vane type water flow devices may be used in zoned sections of the sprinkler systems.

b. All pressure operated water flow alarm devices and vane-type switches shall be installed in accordance with manufacturer's recommendations, be completely factory assembled, and be piped and wired to meet the field conditions. Wiring to control circuit shall be as specified in the electrical specification.

c. Water flow devices of the vane type shall have two, single-pole, double-throw micro switches, and have adjustable pneumatic retard to prevent alarm signals due to surges. Water flow devices shall be Potter Electrical Signal Co. "Switch" or "Switch/transmitter" type, or an approved equal.

d. The vane type Alarm Actuating devices are to be installed a minimum of 18 in. from any flange, elbow, check valve or other fitting to minimize water surges and flow turbulence.

e. Tamper switch for Preaction system is specified in Section B b.

F. Control valves for fire standpipe fire hose cabinet shall be angle hose valves, Potter-Roemer, Figure 4075H, 2-1/2 in. tested and certified to 1000 lbs for World Trade Center use only. Valves are in stock at the WTC Stockroom and are available for contractor to purchase.

G. Sprinkler Heads

a. In all finished areas, sprinkler heads shall be Reliable Automatic Sprinkler Co., Model G4 "Concealer," BS&A 587-75-SA, with a 165° F temperature rating. The cover plate of heads must be chrome plated, not factory painted white. For 1, 2, 5 WTC and all Concouse and Plaza Levels, orifice size shall be ½", in 4 WTC, 3rd floor and above, orifice size shall be 7/16".

b. Sprinkler heads in areas without hung ceiling shall be upright or pendent type, Reliable Automatic Sprinkler Co., Model G, BS&A 587-75-SA, with a 165° F temperature rating. For 1, 2, and 5 WTC, orifice size shall be ½", in 4 WTC orifice size shall be 7/16".

c. Sprinkler heads for dry-pipe system concealed within hung ceiling shall be chrome-plated, pendent dry type, Reliable Automatic Sprinkler Co. Model G3, with a 165° F temperature rating. For 1, 2, and 5 WTC, orifice size shall be ½", in 4 WTC orifice size shall be 7/16".

d. Protective guards or shields shall be provided for exposed sprinklers which are so located as to be subject to mechanical injury.

e. Large drop sprinklers, Sidewall sprinklers and Early Suppression Fast Response (ESFR) sprinklers are not permitted in the World Trade Center.

H. Sleeves and Escutcheons

a. Sleeves for piping passing through masonry walls shall be Schedule 40, standard galvanized steel pipe; framed partition openings shall be 20 gauge sheet metal. The space between the pipe and its sleeve shall not exceed one-half inch. The sleeve shall have a sufficient length to be flush with the finished wall surfaces.

b. Exposed piping passing through walls, floor or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

I. Insulation

a. Insulate all sprinkler piping and fittings within (15) fifteen feet of exterior wall. Pipe insulation shall be one in. thick, Manville Micro LOCK Fiberglass with all service jacket, or an approved equal.

b. All insulation (including jacket, or facing and adhesive) shall have composite fire and smoke hazard ratings, as tested by procedure ASTM E-84, NFPA 255 and UL 723 not exceeding a "Flame Spread" of 25 and "Smoke Developed" of 50.

c. Fittings, valves, flanges and accessories shall be insulated with compressed fiberglass and wired in place with 18-gauge galvanized steel wire. That the entire surface will be coated with a uniform coat of a fire retardant vapor barrier, and have embedded into the wet coat a layer of fiberglass tape extending 2 in. onto adjacent pipe covering. Pre-molded PVC insulation covers are not permitted.

d. Specify all insulation materials from one of the following manufacturers:

Manville Corp.
Certain-Teed Corp./Insulation Group
Owens-Corning Fiberglass Corp.
Knauf Fiber Glass

5. ACCESSORIES

A. Pressure Gauges

Gauges shall be cast iron case, 4-1/2 in. in diameter, aluminum ring-bronze bourdon tube, all brass linkage, ½ in. bottom connection, black pointer, white face with black figures and segment range of 0-200 psi, 20 psi figure intervals, 2 psi intermediate graduations. Dial shall have red marker at 175 psi. Gauges shall be Dresser Industries Inc. "Ashcroft Series 1079", or an approved equal.

B. Sight Glass

a. Wherever test connection connects to closed drain or spill to receptacle located remotely from a test control valve, provide a sight test connection, having a smooth bore noncorrosive orifice giving a flow equivalent to one sprinkler.

b. Wherever sprinkler drain lines connect to closed drain lines or spill to receptacles located remotely from a drain valve, a glass sight drain shall be provided.

C. Pipe and Valve Identification

a. Adhesive Bands

1) Provide adhesive bands in sets of two: one identifies the piping system type and the other shows the direction of flow. The adhesive bands shall be installed where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system.

2) Adhesive bands shall be W.H. Brady Co. "Quick-Label", or an approved equal.

b. Valve Tags

1) Provide tags on the first valve after the connection to the base building connections indicating the tenant's name, system type, and floor served. The tags shall be made of either metal or plexiglass, 3" X 6" size, with green background and black lettering. Securely fasten valve tags with brass chain.

2) Tags and the frames shall be manufactured by Seton Name Plate Corp., or an approved equal.

D. Preaction System Identification

a. Affix identification markers on all Preaction sprinkler piping at 10 foot intervals. Markers shall be Brady, snap-on type "B", manufactured by the W.H. Brady Co., Sing Mark Division. Markers shall read, "PREACTION."

b. Provide a sign at the location of the Preaction assembly. It is to read, "Prior to opening the drain valve on Preaction sprinkler system, open valve on drain termination located in a service sink closet on floor below."

c. Provide a sign in the service sink closet to read, "Drain valve for Preaction sprinkler system on (floor above) for tenant _____." Before opening valve, clean mop receptor of all debris. Make sure valve is closed when finished.

6. HANGERS & SUPPORTS

A. Provide suitable and substantial hangers, anchors and supports for all piping, allow for forces imposed by expansion joints, satisfy structural requirements, and maintain proper clearance with respect to adjacent piping, equipment, and structures.

B. Clevis hangers are required on sprinkler piping larger than one inch; general purpose hangers may be used on one inch sprinkler piping only.

C. Hangers shall be suspended from beam clamps, brackets, fish plates, inserts or other approved means. Drilling/anchoring systems will be permitted into concrete only with the approval by the Architect and the PA/WTD. The use of powder activated tool fastening system is not permitted.

D. Provide protection shields for all insulated piping at all points of support. Shields shall be 12 in. long, galvanized steel plate with a radius suitable for the required applications, including insulation.

E. Tabs in metal deck construction shall not be used to support pipe or equipment.

F. The Contractor shall furnish and install all supplementary structural steel required or spanning between, or connecting to, building structural members, for the hanging or support of piping. Welding to building structural members will not be permitted without the approval of the Architect and the PA/WTD. Drilling and/or bolting into existing structural steel members is not permitted.

G. Hangers may be directly connected to steel beams of building construction by means of approved beam clamps. Smaller pipes may be suspended from cross-pieces of pipe or steel angles, which, in turn, shall be securely fastened to building beams or hung from building concrete construction by means of rods and inserts. Supports in each case shall be adequate so as not to unduly stress the building construction.

H. No piping shall be hung from other piping, ducts, conduits, etc.

I. All pipe hangers, inserts, supports, supplemental steel, rods, and components shall be galvanized.

J. Unless otherwise specifically approved, hanger size and spacing shall be within the following limits:

Pipe Size	Max. Hanger Spacing	Min. Rod Size
1"	8 ft. o.c.	3/8"
1-1/4" to 2"	10 ft. o.c.	3/8"
2-1/2" to 3-1/2"	12 ft. o.c.	½"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8",10" and 12"	12 ft. o.c.	7/8"

The above hanger spacings apply to straight runs of pipe only. At points where valves, specialties, or branch connections are located, additional hangers, or supports shall be used to properly support the load.

K. Hangers and supports shall be manufactured by ITT Grinnell Corp., Bergen-Patterson Inc., Blawknox Co., Michigan Hanger Co., Inc., or an approved equal.

L. If removal of existing fireproofing is required for installation purposes, such removal shall be kept to a minimum. The Contractor shall replace all removed fireproofing with new fireproofing to the satisfaction of the WTC Construction Supervising Engineer at no additional cost.

7. CUTTING AND PATCHING

A. Piping passing through walls shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein.

B. Piping passing through concrete floors shall have the opening core drilled so that the space between the opening and the pipe shall not exceed one-half inch.

C. Annular spaces between piping and sleeves or core drilled floor openings shall be packed with mineral wool and sealed, to retain the fire integrity of the walls and floors, with a non-hardening compound similar or equal to Duxseal as manufactured by J.M. Clipper Corporation.

D. For details of floor coring restrictions in tower buildings, see World Trade Center Drawings S-C1, S-C2 and S-C3.

8. INSTALLATION

A. The entity performing sprinkler work shall have had a minimum of five years experience in the installation of sprinkler systems in the City of New York.

B. Install piping straight and direct as possible, forming right angles or parallel lines with building walls, neatly spaced. Avoid interference with other construction.

C. All pipe is to be reamed smooth before installation. Do not bend, split, flatten nor otherwise injure pipe.

D. Piping shall be laid out to avoid passing over high voltage electric bus duct, switchgear equipment and/or motors or other electric equipment. However, where it is not possible to avoid said items, show on the drawings protective pans under pipes passing over bus duct, switchgear, or equipment. Note and show on the drawings the locations and dimensions of the pans. Pans shall be 18 gauge copper, reinforced to prevent sagging, with the edges of the pans turned up 6 in. on all sides. Braze the corners to make the pans watertight. Support the pan with hangers and drain clear of the electrical work.

E. Piping shall pitch back toward the system drain valve and any installed low points or pockets shall have a hose end drain valve.

F. In the tower buildings all sprinkler piping shall be installed above the bottom chord of truss. Branch lines shall run through bridging trusses.

G. Make changes in pipe size by the use of reducing fittings. Reducing bushings will not be allowed. Unions may be used for sprinkler piping up to 2 in., use flanged connections for 2-1/2 in. and above.

H. Threaded joints shall be made up tight using pipe joint, Teflon compound or tape, applied on the male threads only. No Permafax shall be used.

I. Before the final piping connections are made to equipment and before the sprinkler heads are installed, all piping shall be thoroughly blown out, rodded out, or washed out at least twice, in a manner as directed and approved by

the Engineer, to remove all accumulation of dirt, chips or other deleterious materials. Make all temporary connections and furnish all appliances required for the purpose of cleaning.

J. Sprinkler heads, except in public corridors, shall be centered on ceiling tiles within +/- ½". Sprinkler heads located in corridors shall be located in the center of the corridors.

K. In 1 and 2 WTC, the Contractor shall furnish and install mounted shop drawing for each full floor sprinkler installation. The final as-built shop drawing shall be reduced to a width of two feet and mounted on the inside of the door of the existing closet on each floor which contains the control valve. The drawing shall be covered with a sheet of 1/8 in. lexan and screwed to the door. The drawing must show the entire floor sprinkler installations.

9. HYDRAULIC CALCULATION

A. The Contractor shall prepare and submit hydraulic calculations to the Engineer for approval based upon the design criteria specified by the Engineer and shown on the Contract Drawing.

B. Design criteria for the hydraulic calculations are listed below:
(These criteria must be prepared and complete by the Engineer and submitted with TAA on the construction drawings for approval.)

a. Available static pressure on the floor:

b. The minimum water supply requirement density, gpm per square foot:

c. Area of hydraulic demand:

d. Occupancy hazard classification:

e. Sprinkler piping and fitting material.

f. All existing/proposed pipe sizes.

g. Water flow velocity may not exceed 20 feet per second.

10. TESTS

A. The Contractor shall test the installed sprinkler system in the following manner:

Perform hydrostatic tests for all sections of the piping systems installed under this Section, at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum pressure, when the maximum pressure to be maintained in the system is in excess of 150 psi. The test pressure shall be read from a gauge located at the low elevation point of the individual system, or portion of the system being tested.

B. Fire standpipe test for 1,2,4 and 5 WTC shall be hydrostatic at the following pressure for one hour. The test pressure shall be read from a gauge located at the low elevation point of the individual system, or portion of the system being tested.

Floor Served	Test Pressure	Floor Served	Test Pressure
109th-92nd	200 psig	91st-82nd	250 psig
81st-73rd	300 psig	72nd-64th	350 psig
63rd-54th	400 psig	53rd-44th	450 psig
43rd-36th	500 psig	35th-26th	550 psig
25th-17th	600 psig	16th-7th	650 psig
6th-B-3 Level	700 psig	B-4-B-6 Level	750 psig

C. The test shall be made in the presence of the consultant or his representatives and the PA/WTC Construction Inspector. At least 48 hours advanced notice shall be given to the PA/WTC Construction Inspector.

D. Should the tests reveal any leaks or deficiencies in the system, make necessary corrections immediately and flush, clean and retest the system for the Engineer's approval at no additional cost.

E. For Preaction Systems: In addition to the hydrostatic test, the Contractor shall perform an operating test utilizing the detection system to verify the low air alarm and deluge valve release performance.

11. SUPPLEMENTARY NEW YORK CITY SPRINKLER NOTES

The following are minimum criteria, but do not supersede the requirements listed in the rest of the guide specification.

A. The installation components, spacing, location, clearances, position and type of systems shall conform to RS 17-2 and 27-954.

B. In accordance with Paragraph 27-958 only approved material will be used.

C. Sprinklers will be protected against freezing and injury in accordance with Paragraph 27-966.

D. Inspection and tests of sprinkler system shall be conducted as specified in Paragraph 27-967.

E. The occupancies of the areas to be sprinklered in accordance with Chapter 1-7 of RS 17-2 shall be those specified on the plans.

F. Piping specification, pipe schedules, system test pipes, protection against corrosion, damage, fittings, valves, hangers, sprinklers, guards and shields shall be in accordance with chapter 3 of RS 17-2.

G. Stock of extra sprinklers will be furnished to comply with Chapter 3-11.7 of RS17-2.

H. Spacing, location and position of sprinklers will be in accordance with Chapter 4 of RS 17-2.

I. All blind spaces exceeding 6 in. In width or depth which contain combustible material will be sprinklered.

J. All piping passing through walls will comply with Paragraph 27.343.

K. There is no high-piled storage as defined in Chapter 4-1.3.10 of RS 17-2.

L. Distance of sprinklers from heat sources shall be in accordance with Table 3-11.6.3(a) of RS 17-2.

M. All valves shall be identified as required by RS 17-2, Chapter 3-9.4

N. Drainage to conform to Chapter 3-6 of RS 17-2.

O. A one piece reducing fitting of good design shall be used wherever a change is made in the size of pipe to comply with Section 3-8.3 of RS 17-2.

P. All valves on connections to water supplies and in supply to sprinklers shall be approved OS&Y or approved indicator type.

Q. Drain valves and test valves shall be approved type in accordance with Section 3-9.1.2 of RS 17-2.

R. Sprinkler heads shall be of approved type in accordance with Section 3-11.2 of RS 17-2.

S. Temperature rating shall comply with Section 3-11.6 of RS 17-2.

T. Maintain a minimum of 18" clearance between top of storage and the ceiling sprinkler deflector in accordance with Section 4-2.5 of RS 17-2.

U. Spacing and location of sprinklers shall comply with Chapter 4 of RS 17-2.

V. Distance from a sprinkler deflector to smooth ceiling shall comply with Section 4-3.1 of RS 17-2.

W. Sprinkler system complies with NFPA 13, as modified by the New York City Building Code RS 17-2 and Board of Standards and Appeals Cal. No.310-90-BCR.

PLUMBING DESIGN GUIDELINES

A. GENERAL

1. Men's and women's rooms are provided in the public lobby on each tenant floor for 1,2,4 and 5 WTC. Modification to base building public toilet rooms and installations of tenant proprietary toilets room shall be designed to comply with Port Authority/World Trade Center (PA/WTC) and the latest Americans With Disabilities Act (ADA) requirements.

2. Building standard finishes in tenant spaces for the World Trade Center do not include any tenants' plumbing work. Plumbing requirements, such as tenant proprietary toilet rooms, pantry rooms, sinks and drinking fountains, may be provided at tenant expense subject to the capacity of the building's system and the approval of the Port Authority/World Trade Department.

3. On each floor of the 1 WTC and 2 WTC, wet columns that serve the tenant's spaces are listed below. Other base building plumbing risers must not be used.

Column No.	Quadrant Served in 1 WTC	Quadrant Served in 2 WTC
501	NW	SW
508	NE	NW
1001	SW	SE
1008	SE	NE

4. Whenever tapping into base building plumbing utilities or using existing capped or plugged outlets, full sized provisions for future use must be made.

   In 1 WTC and 2 WTC, typical sizes of plugged outlets of soil/waste and vent for future use shall be 4 in. and 3 in., respectively. Typical sizes of capped outlets of cold water and hot water for future use shall be 2 in. and 1 in., respectively. For individual wet column details and sections, refer to WTC base building drawings P-A-72 and 73 for Tower 1, P-B-72 and 73 for Tower 2. Requirements for tie-in to existing capped outlets and a typical piping connections at wet columns are shown in Sketches P-2 and P-3.

5. Pressure Reducing Valves (PRVs) are required on those floors where the base building working pressure is equal to or greater than 85 psig. For water working pressure refer to base building water riser diagram drawings P-A-82 through P-A-87 for 1 WTC, and P-B-82 through P-B-87 for 2 WTC.

Location of PRV shall be on the branch main serving the tenant equipment. Tenant is responsible for the maintenance of the PRV(s) that serve tenant's equipment.

Domestic water systems in 4 WTC, 5 WTC, Concourse, and Subgrade areas do not require the PRV.

6. A check valve installed in cold water piping is required to prevent backflow from hot water to cold water in three-way mixing valve installation.

7. Tenants who have plumbing equipment/fixtures for other than the normal office occupancy usage shall install individual water meter(s) on the domestic hot and cold water lines. Normal office occupancy usage includes toilet rooms, lavatories, drinking fountains, pantry rooms, AC humidifiers, etc.

8. Odor generated from cooking or food warming equipment, are not permitted in any areas including pantry rooms and lunch rooms. See HVAC Guide for exhaust options.

9. Tenant proprietary water closets shall be wall mounted type with a pipe chase in the back. All pipe chases shall be treated as floor penetrations for structural design. See the Structural Design Guide for the floor coring restrictions. Refer to WTC Structural Design Guidelines for coring details.

10. The color of "Fawn Beige" or" match existing" shall be specified for all base building public toilet room new fixtures.

11. Domestic hot water design temperature is at 120° F.

12. Drinking fountains (or water coolers) shall not be tied into existing cold water lines serving the public toilet rooms. Any drinking fountain, having a direct water connection must have a drain piped to a waste line.

13. Restaurant designs shall include indirect waste and grease interceptors to comply with NYC Building Plumbing Code, NYC Department of Health Code, and New York State Sanitary Code.

14. Refer to " HVAC Design Guildlines, Restaurant Tenant Requirements Section " for details regarding gas detection system and utility load requirements.

15. Refer to "Tenant Construction Review Manual", by Engineering Quality Assurance Division of Port Authority Engineering Department, Section eleven (11) for other representative details that may be required for review.

16. For complete WTC Plumbing specifications, refer to Part II: Plumbing Guide Specification For Tenant Alteration Design". This Guide Specification is to be used by tenant's consultant as an aid in preparing his own specification.

17. Refer to Attachments P-1 through P-5, and HVAC-2 for WTC Plumbing Standard Details. They shall be shown on drawings where applicable.

PLUMING SPECIFICATIONS

This specification provides the tenant's consultant engineer with WTC requirements for the plumbing systems normally required by WTC tenants. The substance of this information must appear in the construction documents as required

1. GENERAL

A. The Contract Drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements. The Contractor shall examine the site of the proposed work to determine the existing conditions that may affect his work.

B. The construction documents shall call for finished work, tested and ready for operation. All materials shall be new and of first-quality.

C. Design, fabrication, installation, and performance of the work shall comply with the manufacturer's recommendations, and all applicable provisions of the codes, standards, and of the entities listed below:

PANYNJ	Port Authority of New York and New Jersey
NYCBC	New York City Building Code
NYCDOH	New York City Department of Health
NYSSC	New York State Sanitary Code
NYSECC	New York State Energy Conservation Construction Code
ASTM	American Society For Testing Materials
ANSI	American National Standards Institute

D. All materials, work, incidental accessories or other details not shown but necessary to make the work complete and ready for operation, even if not shown or specified in the construction documents, shall be provided by the Contractor at no additional cost.

E. Existing pipes, fixtures, utilities, etc. that are damaged during construction period, whether or not due to the Contractor's negligence, shall be repaired or replaced by the Contractor and left in a condition satisfactory to the WTC Construction Supervising Engineer.

F. All plumbing work shall be free from defect in workmanship and materials for a period of one (1) year from date of final acceptance and shall meet all local and state codes. All defects, which develop or are discovered within this period, shall be repaired by the Contractor to the satisfaction of the tenant at no additional cost.

G. Coordinate all work to minimize interference with existing facilities.

H. Connect new work in neat and approved manner. Restore existing piping disturbed in making such connections to perfect conditions. If existing piping is found not in a serviceable condition during the construction, replacement must be made in accordance with the latest PA/WTC standard.

I. The Contractor shall request domestic water riser shutdown 10 working days notice in advance by notifying the PA/WTC Construction Inspector who will coordinate the shutdown. The Contractor shall insure that drainage will be discharged to an approved location or receptacle without causing damage to other work and property.

J. All unused piping, hangers, supports shall be completely removed all the way back to the core wet columns, or back to the nearest active branch main and capped, sealed watertight. All the openings resulting shall be properly patched, sealed and firestopped to maintain the original integrity of the partition's fire rating.

2. SCOPE OF WORK

(To be finished by tenant's consultant)

3. SUBMITTALS

A. The following items must be submitted to the tenant's engineers for review and approval:

a. Detailed piping layout drawings, including hanger and support locations and details

b. Catalog cuts for the following:

-Fitting and flanges
-Valves
-Hangers and supports
-Sleeves and escutcheons
-Valve tags and piping identification bands

c. Manufacturer's certification of pipe material and schedule for each piping system

d. Valve charts and schedules

e. List of access doors including manufacturer, material, and sizes.

f. Operation and maintenance manuals, including replacement and spare parts lists, for each type of valve.

g. Field hydrostatic test results.

h. Potable water purity test results on new or altered potable water pipe system.

B. The approval and submission of all As-Built drawings is the responsibility of the tenant's consultant. One (1) reproducible Mylar copy and one (1) CAD diskette (3-1/2", 1.44 MB floppy) of the approved as-built drawings, must be submitted to the TAA Project Manager in WTC Tenant Services Division for record purposes. The Mylar reproducibles must be stamped "As Built" and signed by the tenant's consultant and the Contractor.

4. PRODUCTS

A. Pipe and Fittings

a. Domestic water piping shall be type "TP" threadless copper pipe, conforming to ASTM B302. The fittings shall be cast bronze for brazing, conforming to ANSI B16.18. No other type materials and fittings are allowed.

b. Waste including indirect waste, soil, and vent piping 4-inches and under shall be ASTM A53 galvanized steel, Schedule 40, with galvanized cast iron ANSI B16.12, Class 125, screwed fittings. No-hub piping is not permitted.

Waste, Soil and vent piping over 4-inches shall be ASTM A74 cast iron, service weight hub and spigot type with cauked joints. The pipe shall pack firmly with hemp or picked oakum and fill with molten lead. After the lead has cooled, the joints shall be thoroughly caulked, using approved caulking irons.

c. Make-up threaded joints tight using pipe joint Teflon compound or tape, applied on the male thread only.

d. The Contractor shall not braze within 12 in. of any valve. Provide threaded to brazed end adapter for brazed installation.

B. Valves

a. General

Specify each type of valve required for the work in the construction documents by manufacturer. Each type of valve shall be the product of one of the following manufacturers, or of an approved equal:

-Walworth Co.
-Jenkins Bros.
-NIBCO Inc.
-Stockham Valves and Fittings

b. Ball Valves

All shutoff valves shall be ball type: Class 150, bronze body, full port, bronze trim, threaded or soldered ends.

c. Globe Valves

Class 150, bronze body, screw-in bonnet, rising stem, integral seat, renewable disc, threaded or soldered ends, for hot water circulation piping or balancing.

d. Drain Valves

Class 150, gate valve, bronze body, screw-in bonnet, rising stem, solid wedge, threaded or soldered ends on inlet side of valve; hose end thread with cap on the outlet side.

e. Check Valves

1) For piping 2 in. and smaller: Class 150, bronze body, horizontal swing, renewable disc, threaded or soldered ends.

2) For piping 2-1/2 in. and larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat, flanged ends.

f. Pressure Reducing Valves (PRV)

PRV set to maintain a constant discharge pressure regardless of changing flow rate and/or varying inlet pressure shall be specified. The minimum downstream pressure at full flow shall be 35 psi.

PRV shall be J.R. Gunzenhauser JRGURED Model 1130H, or an approved equal.

C. Sleeves and Escutcheons

a. Sleeves for piping passing through masonry walls shall be schedule 40, standard galvanized steel pipe; in framed partitions shall be 20 gauge sheet metal. The space between the pipe and its sleeve shall not exceed one-half inch. The sleeve shall have a sufficient length to be flush with the finished wall surfaces.

b. Exposed piping passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

D. Plumbing Fixtures

a. Fixture selections shall comply with the latest New York City Local Law 29 for water saving performance standards and ADA Guidelines.

b. Provide with stop valves and CP brass trim.

c. (Fixtures to be furnished by Tenant's consultant)

E. Insulation

a. Provide insulation materials from one of the following manufacturers:

-Manville Corp.
-Certain-Teed Corp./Insulation Group
-Owens-Corning Fiberglass Corp.
-Knauf Fiber Glass

b. Insulation for domestic cold water pipe shall be minimum of ½ in. thick one piece fiberglass. All pipe insulation shall have a flame spread rating not greater than "25", smoke rating not greater than "50".

c. Minimum piping insulation for domestic hot water pipe shall comply with New York State Energy Conservation Construction Code, Table 4-4. Material requirement shall be same as for domestic cold water insulation.

d. Fittings, valves, and flanges shall be insulated with compressed fiberglass and wired in place with 18-gauge galvanized steel wire. Apply a uniform coat of fire retardant vapor barrier coating to the entire surface. Then embed into wet coat a layer of fiberglass tape extending 2 in. onto adjacent pipe covering. Pre-molded PVC insulation covers for fittings are not allowed.

F. Water Meters

a. The meter shall be Hersey, Rockwell, Neptune or Trident, Cyclometer digital read-out type, or an approved equal.

b. The meter shall be set horizontally, dial facing upward not more than three feet above floor and properly supported. Remote attachments to facilitate reading must be provided if meters are installed in the ceiling of tenant space.

c. Shutoff valve is required before and after the meter for maintenance purpose.

d. A reduced pressure backflow preventer, as manufactured by Conbraco Industries, Inc. "XL" series, or an approved equal, shall be provided after the water meter device, before any fixture/equipment connection.

G. Vacuum Breakers

Vacuum breakers shall be bronze body, chrome-plated Watts Regulator Co. Model No. 288A-C or an approved equal. Check valve shall be provided at the outlet side of vacuum breaker.

H. Backflow Preventers

a. Where shown on the Contract Drawings provides backflow preventers to prevent the backflow of contaminated water into the potable water supply. Each backflow preventer shall be a complete assembly, including tight-closing shut-off valve before and after the device, and shall be protected by a strainer. The design shall include test cocks and a pressure-differential relief valve located between two positive seating check valves. The device shall meet the requirements of ASSE Standard 1013.

b. For each backflow preventers indicate the size and specify in the construction documents CMB Industries/FEBCO Division Model No. 825, Watts Regulator Co. Model No. 909, or an approved equal.

c. Installation details including location of drainage requirements shall be submitted to the Port Authority for approval.

I. Dielectric Fittings

Connections between ferrous and non-ferrous pipe or equipment connections shall be made using isolating union or flange joints as manufactured by Epso Salaes Inc. or an approved equal.

J. Floor Drain

a. Floor drain installation detail (Attachment WTC-P-5) shown on the Contract Drawing is based on Jay R. Smith series 2010 with threaded outlet. Actual selection of the floor drain shall be based on intended application.

b. Waterproof existing of room where floor drain is to be located using Thoroseal sealant or an approved equal for floor application.

K. Cleanouts

a. Use "Y" (and "TY") fittings for cleanouts. Use full size "Y" for piping up to 4 in. Use minimum 4-inch "Y" outlets for piping 5 in. and larger.

b. Provide cleanouts for storm and sanitary piping at bases of stacks, at changes in direction of horizontal piping, and at 50-foot intervals, minimum, for horizontal runs.

c. Toilet room wall cleanouts shall be cast iron caulk ferule and cast iron head seal plug with stainless steel cover and center screw; Jay R. Smith No. 4402, or an approved equal.

d. Cleanouts at changes of direction of direction of above-floor piping shall be cast iron caulk ferrule with straight threaded, tapered bronze plug and raised hex head; Jay R. Smith No. 4425, or an approved equal.

e. All cleanout plugs shall be lubricated with graphite before installation.

f. Cleanouts shall be manufactured by Jay R. Smith Manufacturing Co., Josam Manufacturing Co., Zurn Industries Inc., Tyler Pipe Industries Inc./Wade Division, or an approved equal.

5. ACCESSORIES

A. Pipe and Valve Identification

a. Adhesive Bands

1) Provide adhesive bands in sets of two: one identifies the piping system type and the other shows the direction of flow. The adhesive bands shall be installed where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system.

2) Adhesive bands shall be W.H. Brady Co. "Quick-Label", or an approved equal.

b. Valve Tags

Provide tags on valves in the base building riser connections indicating the tenant's name, system type, and floor served. The tags shall be made of either metal or plexiglass, 3" X 6" size, with green background and black lettering.

6. HANGERS AND SUPPORTS

A. All supports and parts shall conform to the latest requirements of the ANSI Code for pressure piping B31.10 and MSS Standard Practice SP-58.

B. Pipe hangers, rods, inserts and clamps shall be those approved for their respective uses by the Underwriters' Laboratories, Inc.

C. Install suitable and substantial pipe hangers (adjustable heavy clevis type) supports, guides and anchors adequate to support and guide the piping.

D. Hangers shall be suspended from beam clamps, brackets, fish plates, inserts or other approved means. Drilling/anchoring systems will be permitted into concrete only with the approval by the Architect and the Port Authority of New York and New Jersey. The use of powder activated tool fastening system is not permitted.

E. Tabs in metal deck construction shall not be used to support pipe or equipment.

F. The Contractor shall furnish and install all supplementary structural steel required or spanning between, or connecting to, building structural members, for the hanging or support of piping. Welding to building structural members will not be permitted without the approval of the Architect and the Port Authority. Drilling and bolting into existing structural steel members are not permitted.

G. Hangers may be directly connected to steel beams of building construction by means of approved beam clamps. Smaller pipes may be suspended from cross-pieces of pipe or steel angles, which, in turn, shall be securely fastened to building beams or hung from building concrete construction by means of rods and inserts. Supports in each case shall be adequate so as not to unduly stress the building construction.

H. No piping shall be hung from other piping, ducts, conduit, etc.

I. Copper plate shall be provided for all hangers that will be in direct contact with brass or copper tubing.

J. All pipe hangers, rods supports saddles, insulation shields clamps, etc. shall be furnished with a finish of black protective paint or galvanized as required by Code.

K. Support main vertical piping with steel riser clamps.

L. Vertical risers shall be supported on every floor and at intervals between floors so that no more than 10'-0" of pipe is unsupported.

M. Unless otherwise specifically approved, hanger and rod size and spacing shall be within the following limits:

a. STEEL PIPE

Pipe Size	Max. Hanger Spacing	Min. Rod Size
½" to 1"	8 ft. o.c.	3/8"
1-1/4" to 2"	10 ft. o.c.	3/8"
2-1/2" to 3-1/2"	12 ft. o.c.	½"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8",10" and 12"	12 ft. o.c.	7/8"

b. COPPER TUBE

Pipe Size	Max. Hanger Spacing	Min. Rod Size
½" to 1-1/4"	6 ft. o.c.	3/8"
1-1/2" to 2"	8 ft. o.c.	3/8"
2-1/2" to 3-1/2"	10 ft. o.c.	5/8"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8" and 10"	12 ft. o.c.	7/8"

The above hanger spacings apply to straight runs of pipe only. At points where valves, specialties, or branch connections are located, additional hangers, or supports shall be used to properly support the load.

N. Hangers and supports shall be manufactured by ITT Grinnell Corp., Bergen-Patterson Inc., Blawknox Co., Michigan Hanger Co., Inc., or an approved equal.

7. CUTTING AND PATCHING

A. Piping passing through walls shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein.

B. Piping passing through concrete floors shall have opening core drilled so that the space between the opening and the pipe shall not exceed one-half inch.

C. Annular spaces between piping and sleeves or core drilled floor openings shall be packed with mineral wool and sealed, to retain the fire integrity of the walls and floors, with a non-hardening compound similar or equal to Duxseal as manufactured by J.M. Clipper Corporation.

8. HYDROSTATIC TESTS

A. Domestic Water

a. Cap or plug all outlets. Apply a hydrostatic pressure of 125 psi. The pressure should not drop during a one hour test period.

b. For piping added, relocated or replaced on existing systems, apply a hydrostatic pressure of 50 psi above the existing system pressure. The pressure should not drop during a one hour test period.

B. Sanitary Drainage and Vent

a. When piping is tested in sections, test piping with a pressure equivalent to a 10-foot water head. The water level shall be maintained for one hour.

b. For piping added, relocated or replaced on existing systems, install a test tee at the lowest elevation of each added, relocated or replaced piece of pipe and fill it with water to overflow level or next highest fixture outlet or drain. The water level shall be maintained for one hour.

9. DISINFECTION

The potable water system shall be disinfected prior to use by a method of disinfection in accordance with the New York City Building Code RS 16, P107-27. The potable water purity test result from a New York City certified tester shall be submitted for engineer's review and approval.

10. NATURAL GAS PIPING AND APPURTENANCES

A. Pipe, Fittings and Flanges

a. Gas piping shall be black steel pipe, Schedule 40, Grade B, standard weight, conforming to ASTM A53.

b. Fittings and flanges up to 4 in. shall be black malleable iron, threaded, Class 150, conforming to ASTM B 16.3.

c. Fittings and flanges 5 in. and larger shall be carbon steel, conforming to ANSI B 16.9, ASTM A234, Gr. WPB, same rating as pipe. Buttwelding, forged carbon steel flanges, conforming to ASTM A105, ANSI B15.6, Class 150.

d. Nipples shall be extra heavy shoulder type. No close nipples shall be used. All nipples shall have designation mark of the manufacturer and shall conform to ASTM pipe specifications for system served.

e. All welding elbows shall be long radius pattern unless otherwise shown on the Contract Drawings.

f. Buttwelding fittings shall be manufactured by Tube Turns Inc., Grinnell Corp., or an approved equal.

g. Install gas piping with 1/64 in. per foot downward slope direction of flow.

B. Valves

Gas plug valves shall be lubricated, iron body, 125 psi w.o.g., wrench operated flanged ends for 2-1/2 in. and larger, or threaded ends for 2 in. and under.

Gas cocks 1-1/4 in. and smaller, shall be lever handle or tee head, bronze, straightway, 150 psi w.o.g., threaded ends type.

Both plug valves and gas cocks shall be manufactured by Walworth CO., Olson Technologies/Homestead Valves, or an approved equal.

C. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

D. Gas Meter Assembly

The gas meter and pressure regulating valves will be furnished by the Utility Company, but shall be installed under this Section in accordance with the Utility Company's requirements, unless otherwise shown on the Contract Drawings.

E. Field Test

a. The Contractor shall test the gas pipe system furnished and installed under this Contract. Such test shall be made in the presence of the Architect or his representatives and PA/WTC Construction Inspector. At least 48 hours notice shall be given in advance of all tests.

b. Test gas piping system with compressed air at a pressure equal to 6" of mercury (3 psig). Use a mercury gauge. Test duration shall be not less than one-half hour for each 500 cu. ft. of pipe volume or fraction thereof. When testing a system having a volume less than 10 cu. ft., the test duration may be reduced to 10 minutes. For piping systems having a volume of more than 24,000 cu. ft., the duration of the test need not exceed 24 hours.

c. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make necessary corrections immediately and flush, clean and retest the system for the Engineer's approval at no additional cost.

APPENDIX A

TENANT SUPPLEMENTARY AIR CONDITIONING UNIT CONDENSER WATER DESIGN GUIDELINES

A. GENERAL

1. Supplementary air conditioning unit condenser water design shall comply with the applicable provisions of the New York City Building Code, and with ASHRAE, SMACNA, NFPA, and Port Authority of New York and New Jersey.

2. Condenser water systems are designed to serve special tenant facilities, in particular, computer rooms, conference rooms and trading rooms which have cooling requirements in excess of base building air conditioning system capability. Condenser water is provided on a 24 hours per day, seven days per week basis, permitting operation of connected tenant facilities entirely independent of the base building AC systems. The usage of condenser water is subject to a separate charge.

3. The condenser water systems are closed, recirculating system, providing controlled temperature water for tenant furnished, self-contained, air conditioning units.

4. Valved outlets for connection to the tenants' system are provided at a central point on selected floors and are generally not more than one or two floors from any tenant floor in Tower A or Tower B.

5. Condenser water is available from the 9th Floor to the 106th Floor in 1 WTC (Tower A), the 9th Floor to the 99th Floor in 2 WTC (Tower B), Subgrade, Concourse (selected areas only), 4 WTC (Southeast Plaza Building), and 5 WTC (Northeast Plaza Building).

6. Tenants contemplating use of the condenser water system should submit the estimated cooling load requirement to the Port Authority, World Trade Department, Tenant Technical Services Division, at the earliest possible date, even at the beginning of the lease negotiation process. The information may be preliminary; it need not be final.

B. BASIC REQUIREMENTS

1. Attachment HVAC-CW-1 illustrates the basic requirement for tie-ins to the existing capped outlets. The actual closet piping layout will be different. A field survey of existing condenser water riser closets or connections to valved outlets in hung ceiling is essential.

2. Submit a detailed schematic showing **all** existing and proposed piping connections, sizes, valves in the condenser water closet (for 1 WTC & 2 WTC) or ceiling riser take off areas (for Subgrade, Concourse, 4 WTC and 5 WTC). The detail shall be at a scale of ½" = 1'-0" to reflect actual field installations and clearances. This is required for any change in condenser water use, even though there is no new work proposed at the riser connection to ensure that capped full sized outlets are provided for future use.

3. Existing AC units in prospective tenant space must also be shown on the drawing. Clearly indicate their capacities, locations, and whether they are to be removed, relocated, or to remain for reuse. This is required for both new tenant moving-in and existing tenants adding capacity.

4. Unless otherwise approved, existing AC supplementary units, fans, ducts or piping shall not be reused.

C. DESIGN CRITERIA

1. LOW ZONE CONDENSER WATER SYSTEMS

a. Service Floors: 1 WTC - 9th Floor to 43rd Floor, System 1
2 WTC - 9th Floor to 24th Floor, System 5
2 WTC - 9th Floor to 43rd Floor, System 7

b. System Water Temperatures for System 1 & 7:
Supply (ACWS) = 80° F. nominal*
Return (ACWR) = 90° F.

System Water Temperatures for System 5:
Supply (ACWS) = 85° F. nominal*
Return (ACWR) = 95° F.

*Actual supply temperature may be 5° F higher than the nominal temperature during the month of August when the river water temperature peaks.

c. Tenant Water Allowance: 3 gpm per ton of unit cooling capacity
Maximum temperature rise = 10° F.

d. System Working Pressures: Air conditioning unit condensers, combination of balancing and shutoff valves, water regulating valves and all other equipment in the water cooling circuit shall be designed and rated for the working pressures listed in the following tabulation:

Floor (Inclusive)	1 WTC, System 1 Working Pressure psig	2 WTC, System 5 Working Pressure psig	2 WTC, System 7 Working Pressure psig
9-17	300	200 (9-24)	300
18-26	250		250
27-36	200		200
37-43	150		150

2. HIGH ZONE CONDENSER WATER SYSTEMS

a. Service Floors: 1 WTC - 44th Floor to 106th Floor, System 2
2 WTC - 44th Floor to 74th Floor, System 8
2 WTC - 75th Floor to 98th Floor, System 9

b. System Water Temperatures for Systems 2 & 8:
Supply (ACWS) = 85° F. nominal*
Return (ACWR) = 95° F.

System Water Temperatures for System 9:
Supply (ACWS) = 90° F. nominal*
Return (ACWR) = 100° F.

*Actual supply temperature may be 5° F higher than the nominal temperature during the month of August when the river water temperature peaks.

c. Tenant Water Allowance: 3 gpm per ton of unit cooling capacity
Maximum temperature rise = 10° F.

d. System Working Pressures: Air conditioning unit condensers, combination of balancing and shutoff valves, water regulating valves and all other equipment in the water cooling circuit shall be designed and rated for the working pressures listed in the following tabulation:

Floors (Inclusive)	1 WTC, System 2 Working Pressure psig	2 WTC, System 8 Working Pressure psig	2 WTC, System 9 Working Pressure psig
44-46	415	250	
47-55	400	235	
56-65	350	185	
66-74	300	150	
75-83	250		200
84-93	200		150
94-106	150		150 (94-99)

3. SUBGRADE, CONCOURSE, 4 WTC AND 5 WTC

a. System Working Pressures and Temperatures. Air conditioning unit condensers, water combination of balancing and shutoff valves, water regulating valves and all other equipment in the water cooling circuit shall be designed and rated for the working pressures and temperatures listed in the following tabulation. Please note that these temperatures are nominal. Actual supply temperature may be 5° F higher than the nominal temperature during the month of August when the river water temperature peaks.

System No.		Working Pressure psig	System Water Temperature F Supply (ACWS)	Return(ACWR)
Subgrade	3	150	80	90
Concourse	3	150	80	90
4 WTC	6	150	85	95
5 WTC	4	150	85	95
5 WTC	10**	150	85	95

** System No. 10 is a glycol cooling system.

b. Tenant Water Allowance: 3 gpm per ton of unit cooling capacity
Maximum temperature rise = 10° F.

4. PIPING DESIGN

Condenser water piping between the service valved outlets from the risers (or existing capped outlets) and tenant air conditioning equipment shall be designed in accordance with the following standards:

a. Pipe Sizing: Velocity = 4 feet per second
Maximum Pressure Drop = 4 feet per 100 feet

b. Maximum total head loss across supply and return connections shall not exceed 20 psi.

c. Available maximum capacity at existing riser valved outlets:

Valve Size	GPM
2-1/2 in.	52
3 in.	94
4 in.	190

d. Tie-ins to existing capped outlets shall be full size with full size capped outlets for future use. The full sizes may be 2-1/2 in., 3 in. or 4 in., depending on the floor and the building.

e. The piping from each existing tie-in shall include a 6 in. or longer full sized nipple, a full sized tee, a full sized capped valve on the run outlet of the tee for future use, and a branch sized outlet for the tenant's piping on the side outlet of the tee with tenant's shutoff valve. Close nipples are not permitted.

f. Piping increaser for connecting a small capped outlet to a large pipe shall not be designed. Replace with the larger size pipe as needed.

g. Booster pumps and bypass piping design between supply and return systems shall not be used.

h. Shutoff valves shall be provided for the main takeoff and branch main to the tenant's system. Shutoff valves shall be flanged plug valves for sizes larger than 3 in.; they shall be screwed ball valves for sizes 3 in. and smaller.

I. No wet-tap is permitted.

j. Condenser water piping, except system 10 glycol cooling, does not require the insulation. Glycol piping needs to be insulated.

k. Condenser water piping shall be black steel pipe, Schedule 40, Grade B standard weight, conforming to ASTM A53. Fittings for 3" and below shall be cast iron threaded, Class 250 in accordance with ANSI Standard B 16.4 or malleable iron threaded, Class 300 in

accordance with ANSI B16.3, depending on the rated working pressure. Fittings for above 3 in. size shall be butt weld, steel, schedule 40 and in accordance with ANSI B 16.9.

l. Provide tag on valves in the base building riser closet or ceiling take off area indicating the tenant's name, "Supply" or "Return", and floor served. The tag shall be made of either metal or plexiglass, 3 in.x 6 in. size, with green background and black lettering.

m. Condensate drain piping shall be copper hard temper Type "L", conforming to ASTM B-88 with wrought copper solder joint, conforming to ANSI B16.18.

n. Domestic cold water makeup piping for humidifier shall be type TP, threadless copper piping, conforming to ASTM B302, with bronze fittings and brazed joints conforming to ANSI B16.18. Type L copper tubing is not permitted.

o. Unless otherwise specifically approved, hanger size and spacing shall be as follows:

Steel Piping

Pipe Sizes	Maximum Hanger Spacing	Minimum Rod Sizes
½" to 1"	7 ft. o.c.	3/8"
1-1/4" to 2"	9 ft. o.c.	½"
2-1/2" to 4"	10 ft. o.c.	½"

Copper Tubing

Pipe Sizes	Maximum Hanger Spacing	Minimum Rod Sizes
½" to 1-1/4"	6 ft. o.c.	3/8"
1-1/2" to 2"	8 ft. o.c.	3/8"
2-1/2" to 3-1/2"	10 ft. o.c.	5/8"

The above hanger spacings apply to straight runs of pipe only. At points where valves, specialties or branch connections are located, additional hangers, or supports shall be used to properly support the load.

p. Refer to Attachment HVAC-2 for a standard detail and notes for pipe passing through a rated wall.

5. AIR CONDITIONING UNITS

a. Provide a complete schedule for proposed AC unit(s) to include manufacturer's full name, model number, size, fan data, system capacity, area served, indoor design conditions, outdoor air requirement (auxiliary ventilation air if needed), condenser water flow gpm, design water temperatures, pressure drop, water working pressure, nominal tonnage, electric data, filter type and efficiency, condensate pump data. MEA or BS & A number, mounting type, and weight. AC units shall be designed for use with refrigerant R-22 only.

b. Refer to Attachment HVAC-CW-2 for a typical AC unit condenser water piping arrangement and note.

c. Each AC unit shall be interlocked with its associated condensate pump in such manner that if the pump is not operating, the AC unit shall be locked out; or, alternatively, that the AC unit shutdown on a hi-water condition in the condensate drain pan.

d. AC units having a compressor motor rating of 1 hp, and above, shall be 460 volts, 3 phase, 60 Hz.

e. Indicate standby AC units. Standby AC units shall include a positive interlock (electrical relay and contacts) to ensure that only one unit can operate at a time.

f. Shutoff valves for 3 in. & smaller sizes shall be ball valves, two pieces, threaded ends, bronze body/brass body, furnished with seat & stem seals of reinforced Teflon or PTFE, similar to Stockham S-216, Crane Capri No. 9302, or an approved equal.

g. Combination Balancing & Shutoff Valves shall be the eccentric non-lubricated plug valve, with adjustable memory stop and pressure tap, as manufactured by DeZurik. Rated working pressure and hydrostatic testing pressure (one and one-half times of rated working pressure) must be specified.

- For working pressure up to 175 psig:

1) Sizes 1 in. through 2-1/2 in., DeZurik Series 400, screwed, cast iron conforming to ANSI Class 125.

2) Sizes 3 in. and up, DeZurik Series 100, flanged, cast iron conforming to ANSI Class 125.

- For working pressure From 200 psig through 450 psig:

1) Sizes 2 in. and under, DeZurik Series 100, Fig.128/WG/SP, screwed, carbon steel conforming to ANSI Class 300.

2) Sizes 2-1/2 in. and up, DeZurik Series 100, Fig.128 DFX001, flanged, carbon steel conforming to ANSI Class 300.

h. Condenser Water Regulating Valves shall be two-way, refrigerant pressure actuated, positive shutoff type, as manufactured by Metrex, Model WCCW-3099-SE-2W Series, design working pressure up to 350 psig. For working pressure 350 psig. and higher, indicate the specific working pressure required.

i. For all floor mounted AC units, provide an overflow drain pan with surface water sensing alarm system. The overflow drain pan and water sensing alarm shall be designed and specified in accordance with Attachment HVAC-CW-3. It is also recommended for ceiling mounted AC units.

j. AC units, with total supply air capacity of 2000 cfm and above, shall be provided with a duct-mounted smoke detector, or an area smoke detector for non-ducted type AC installation. Those AC units shall shutdown upon activation of any smoke detector in the area served by the AC unit and have a smoke detection ability to activate the base building Class "E" alarm system through the tenant's smoke detection panel via Cerberus Pyrotronics TRI-60 Series Intelligent Initiating Devices Interface Modules. Smoke detectors are not required for AC units with capacity below 2000 cfm.

k. Systems over 15,000 cfm capacity shall also have a smoke detector in the return air stream.

l. For ceiling mounted AC units over 500 lbs, submit a structural calculation to substantiate the unit's support system designed can carry the load.

m. All AC units must be located inside the tenant spaces. No AC units shall be located in the ceiling of core corridor.

n. Refer to HVAC Guide Specification Section 14 for a complete specification for air conditioning unit.

o. Emergency power for the condenser water system will become available for selected systems in the near future. AC unit's piping design and control as indicated in this guideline may require some modifications if an automatic restart after a power failure is needed, depending on the manufacturer and model type. It is the tenant's responsibility to check with the manufacturer, address all the necessary changes in their design and submit to the Port Authority for approval. A bypass design using a full flow of condenser water is not permitted.

APPENDIX B

AUXILIARY VENTILATION AIR SYSTEM DESIGN GUIDELINES

A. GENERAL

1. The auxiliary ventilation provided is conditioned, 100% outdoor air, high pressure (in Tower A & B only), supply system. It is designed to provide outdoor air for those tenant spaces which require additional ventilation either through ventilation index analysis or off-hour operation.

2. This system shall not be used to supplement the base building air supply.

3. The operating schedule of the auxiliary ventilation system is 24 hours per day, 7 days per week.

4. Connections to this system are generally available at most floors from 9th through 108th in 1 WTC (Tower A), 14th through 106th in 2 WTC (Tower B), 2nd through 8th in 4 WTC (SEPB), and 2nd through 8th in 5 WTC (NEPB).

5. The estimated air quantity required shall be sent to Port Authority, World Trade Department, Tenant and Technical Services Division, Project Manager, prior to the submittal of the Tenant Alteration Application, even during the lease negotiation process. The information may be preliminary; it need not be final.

B. EXISTING SYSTEMS

1. 1 WTC (TOWER A)

System AVS/1, served by WTC base building air handling unit ACS-108-13:

9th through 44th Floors, via shaft 42
45th through 108th Floors, via shaft 5

System AVS/2, served by WTC base building air handling unit ACS-108-12:

22nd through 48th Floors, via shaft 42
49th through 108th Floors, via shaft 12

Please note that shaft numbers 5 and 12 are at different locations depending upon the floor.

2. 2 WTC (TOWER B)

14th through 22nd Floors : served by WTC base building air handling unit ACS-7-15A, via shaft condenser water closet next to Column 706.

23rd through 40th Floors : served by WTC base building air handling unit ACS-41-17, via shafts 1-6 and 1-11.

43rd through 58th Floors : served by WTC base building air handling unit ACS-41-17, via shafts 2-6 and 2-11.

59th through 74th Floors : served by WTC base building air handling unit ACS-75-17, via shafts 2-1 and 2-12.

76th through 82nd Floors : served by WTC base building air handling unit ACS-75-17, via shaft 3-2.

83rd Floor : served by WTC base building air handling unit ACS-75-17, via shaft 3-23.

84th through 106th Floors : served by WTC base building air handling unit ACS-108-S & N, via shafts 3-12 and 3-5, respectively.

3. 4 WTC (SOUTHEAST PLAZA BUILDING)

2nd through 8th Floors : served by WTC base building air handling unit ACS-9-8, via west, north, and east shafts.

4. 5 WTC (NORTHEAST PLAZA BUILDING)

2nd through 8th Floors : served by WTC base building air handling unit ACS-9-14N, via shaft No. 9 between Columns E6/30 and E6/31.

C. DESIGN CRITERIA

1. Supply air temperatures for most systems, except ACS-108-S & N, are 50° F in winter and 60° F D.B. in summer. For ACS-108-S and N, supply air temperature is 70° F in winter and 63° F D.B. in summer.

2. Riser tap sizes in 1 WTC and 2 WTC are either 6", 8", or 10"dia., depending on the systems and floors they serve. In 4 WTC, tap size is 15" by 15". In 5 WTC, tap size is 10".

3. Tenant air allowance is at an average of 200 to 400 cfm per occupied floor in 1 WTC and 2 WTC, and it varies in 4 WTC and 5 WTC. Existing 10" riser taps may be used for air quantities up to 750 cfm. Larger quantities and field modified taps are subject to the Port Authority's approval.

4. Static pressure at riser tap shall be checked before connection is made.

5. Existing unused ducts and CVRs shall not be reused.

6. Submit a detail drawing showing existing and proposed duct connections. The detail shall be at a scale of 1/2' = 1'-0".

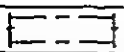
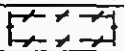
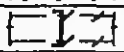
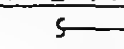
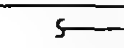
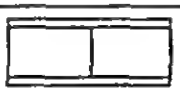
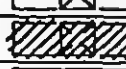
7. Tenant duct connections to existing taps shall be made the same size as the tap connection and shall include an approved fire damper and access door at the shaft wall followed by a tee with a side outlet to the tenant. The provision for future full size (same as riser tap size) capped outlet shall be in the straight run. Reduction in duct size to suit tenant air quantity shall be made beyond this tee fitting.

8. Each tenant ventilation air duct system shall include a mechanical constant volume regulator (CVR), factory calibrated and set for the required air quantity and equipped with an accessible calibrated cfm dial control. Constant volume regulator for auxiliary ventilation air shall be Anemostat Model HVE with a MCV box, size xx, or Phoenix Control Corp. Air Flow Control Valve, Model CVV, designed for a minimum inlet static pressure of 3 inches w.g. for 1 WTC and 2 WTC.

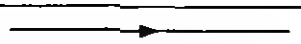
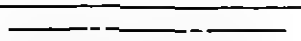
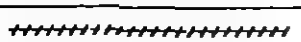
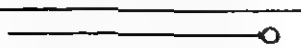
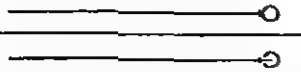
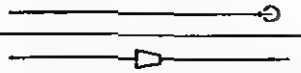
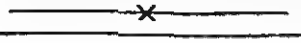
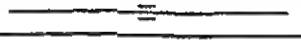
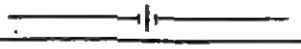
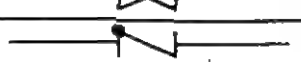
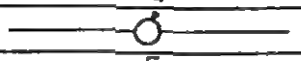
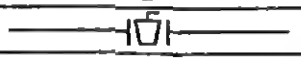
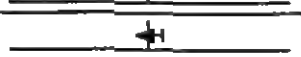
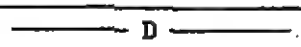
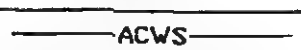
9. The location of CVR shall be within the tenant's space.

10. Ducts from the riser tap to the CVR shall be high pressure construction for 1 WTC and 2 WTC. Acoustic treatment of ducts shall be provided as required.

11. Provide a complete specification for ducts and CVR. Refer to Part II Guide Specification for more detail.

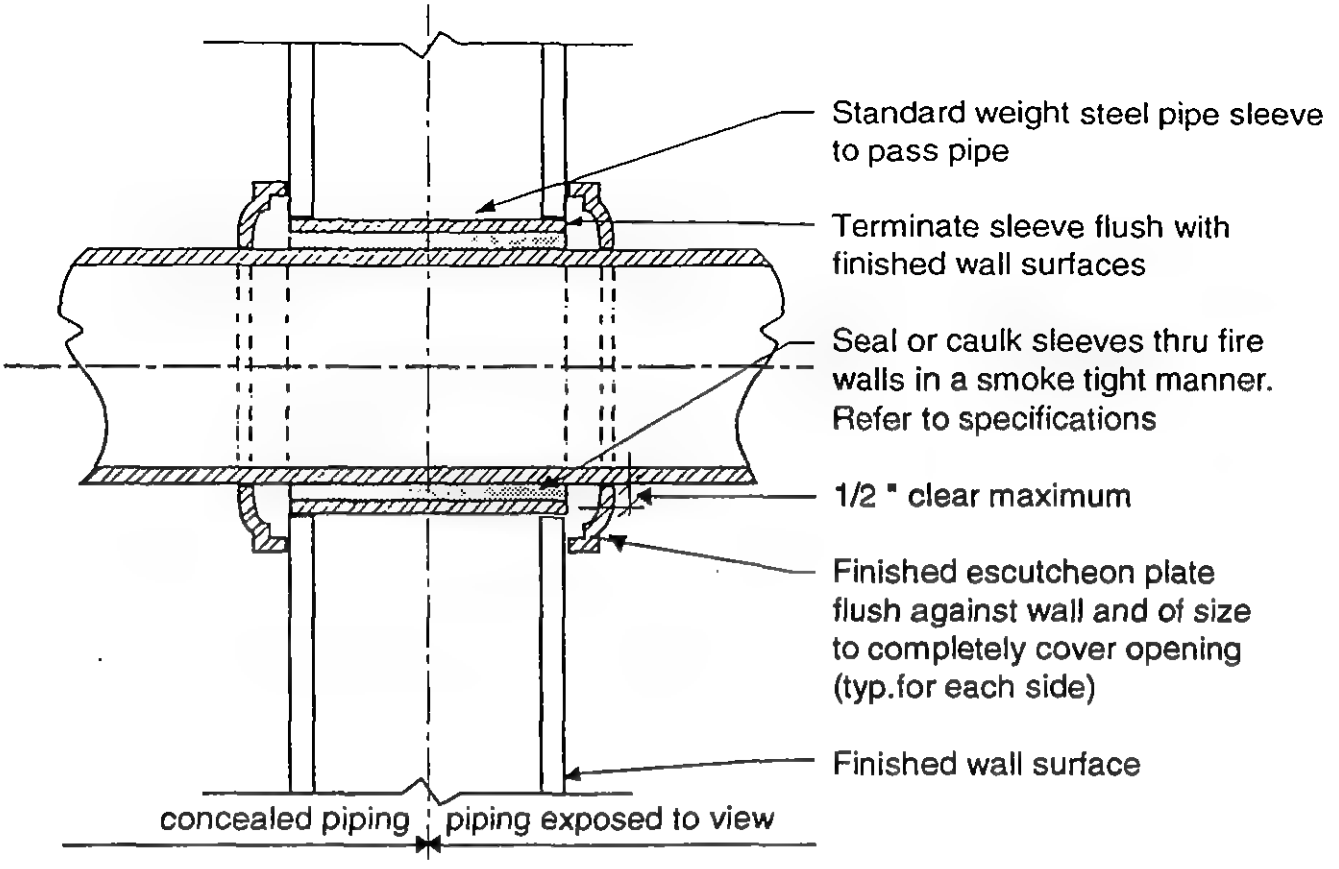
HVAC SYMBOLS	
	EXISTING DUCT TO REMAIN
	NEW DUCT TO BE INSTALLED
	EXISTING DUCT TO BE REMOVED
	EXISTING DUCT TO BE CAPPED
	VOLUME DAMPER
	FIRE DAMPER AND ACCESS DOOR
	EXISTING CEILING DAMPER TO REMAIN
	EXISTING CEILING DIFFUSER TO BE REMOVED
	CEILING DIFFUSER
	CEILING GRILLE OR REGISTER
	TWO WAY CEILING DIFFUSER
	EXISTING LIGHT TROFFER DIFFUSER TO BE REMOVED (DOUBLE AIR POUCH)
	EXISTING LIGHT TROFFER DIFFUSER TO REMAIN (SINGLE AIR POUCH)
	EXISTING LIGHT TROFFER DIFFUSER TO REMAIN (DOUBLE AIR POUCH)
	CONNECTION TO EXISTING WORK
	TRANSFER DUCT WITH FIRE DAMPER AND 1" ACOUSTICAL LINING
	LOUVERED DOOR
	FLEXIBLE CONNECTION
	EXISTING DUCT TRANSITION
	CENTRIFUGAL FANS
	SMOKE DETECTOR
	THERMOSTAT
	EXISTING FULL CAPACITY INDUCTION UNIT TO REMAIN
	EXISTING FULL CAPACITY INDUCTION UNIT TO BE REMOVED
	NEW FULL CAPACITY INDUCTION UNIT
	EXISTING INDUCTION UNIT (HALF CAPACITY) TO REMAIN
	EXISTING INDUCTION UNIT (HALF CAPACITY) TO BE REMOVED
	EXISTING INDUCTION UNIT BALANCED TO HALF CAPACITY
	EXISTING 1-1/2 CAPACITY INDUCTION UNIT TO REMAIN
	EXISTING 1-1/2 CAPACITY INDUCTION UNIT TO BE REMOVED
	NEW 1-1/2 LARGE CAPACITY INDUCTION UNIT

HVAC SYMBOLS

HVAC SYMBOLS	
	NEW PIPE WITH DIRECTION OF FLOW
	EXISTING PIPE TO REMAIN
	EXISTING PIPE TO BE REMOVED
	PIPE TURNING UP
	PIPE TURNING DOWN
	REDUCING FITTING
	PIPE ANCHOR
	PIPE GUIDE
	UNION
	PUMP (INDICATE TYPE)
	BALL VALVE
	GLOBE VALVE
	GATE VALVE
	CHECK VALVE
	AUTOMATIC TWO-WAY CONTROL VALVE
	STRAINER 'Y' TYPE WITH BLOWDOWN VALVE
	RELIEF VALVE
	NON-LUBRICATED PLUG VALVE
	VACUUM BREAKER
	THERMOMETER
	PLUG FOR PRESSURE GAUGE AND THERMOMETER CONNECTION
	MANUAL AIR VENT
	AUTOMATIC AIR VENT
	NEEDLE VALVE COCK
	CHILLED WATER SUPPLY
	CHILLED WATER RETURN
	CONDENSATE RETURN
	DRAIN LINE
	REHEAT HOT WATER SUPPLY
	REHEAT HOT WATER RETURN
	AUXILIARY CONDENSER WATER SUPPLY
	AUXILIARY CONDENSER WATER RETURN
	LOW PRESSURE STEAM
	LOW PRESSURE CONDENSATE RETURN
	STEAM TRAP (INDICATE TYPE)

HVAC SYMBOLS

CAD REF:HVAC-1B



TYPICAL DETAIL OF PIPE INSTALLATION THRU RATED WALL

Not to Scale

SLEEVES AND ESCUTCHEONS

A. Sleeves for piping through masonry wall shall be schedule 40, standard galvanized steel pipe; in framed partitions shall be 20 gauge sheet metal. The space between the pipe and its sleeve shall not exceed one-half inch.The sleeve shall have a sufficient length to be flush with the finished wall surfaces.

B. Exposed piping passing through walls, floors, or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

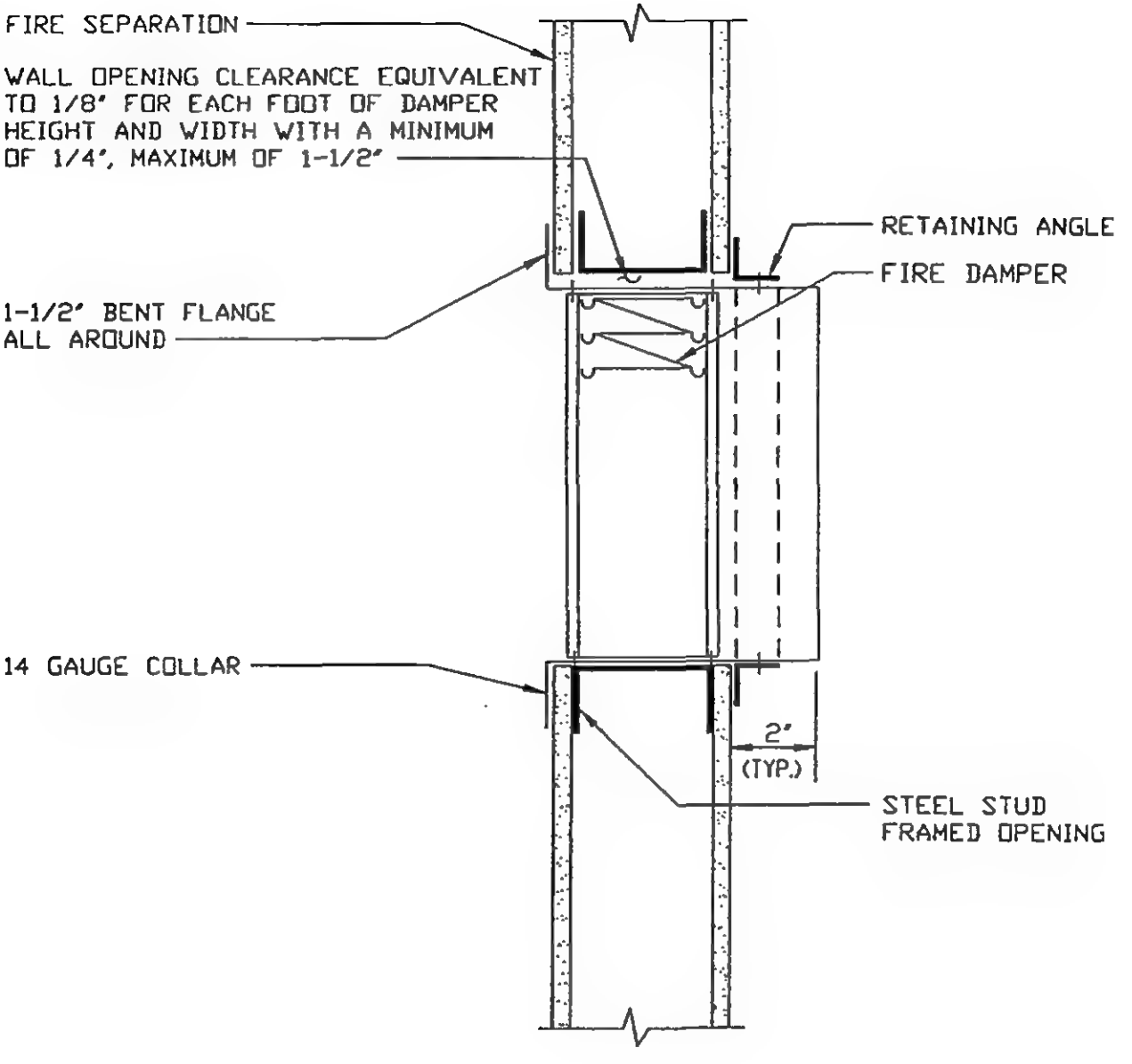
CUTTING AND PATCHING

A. Piping passing through walls shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein.

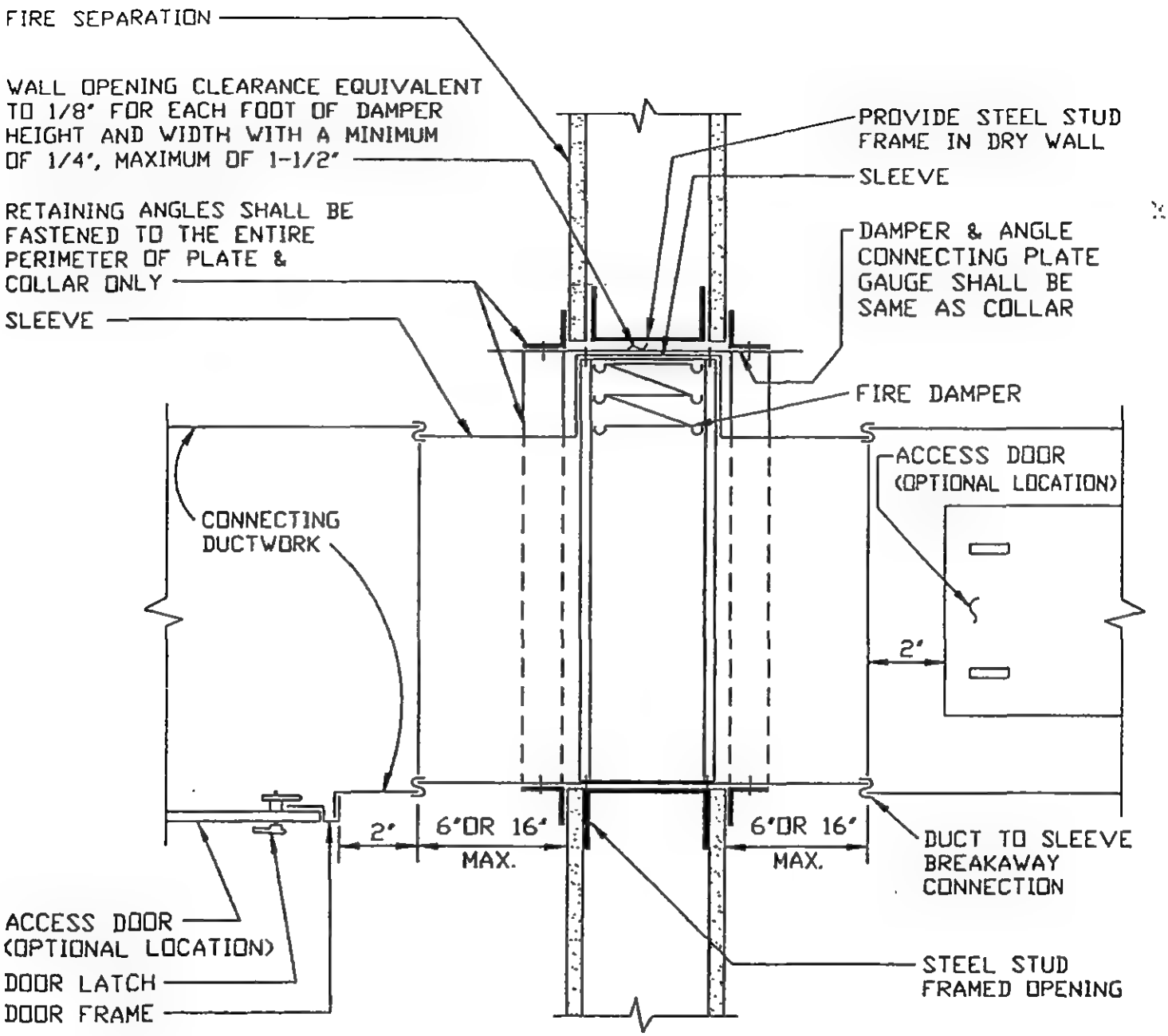
B. Piping passing through concrete floors shall have an opening core drilled so that the space between the opening and the pipe shall not exceed one-half inch.

C. Annular spaces between piping and sleeves or core drilled floor openings shall be packed with mineral wool and sealed, to retain the fire integrity of the walls and floors, with a non-hardening compound similar or equal to Duxseal as manufactured by the J.M. Clipper Corp.

D. For details of floor coring restrictions in tower buildings, see drawings S-C1, S-C2 & S-C3.

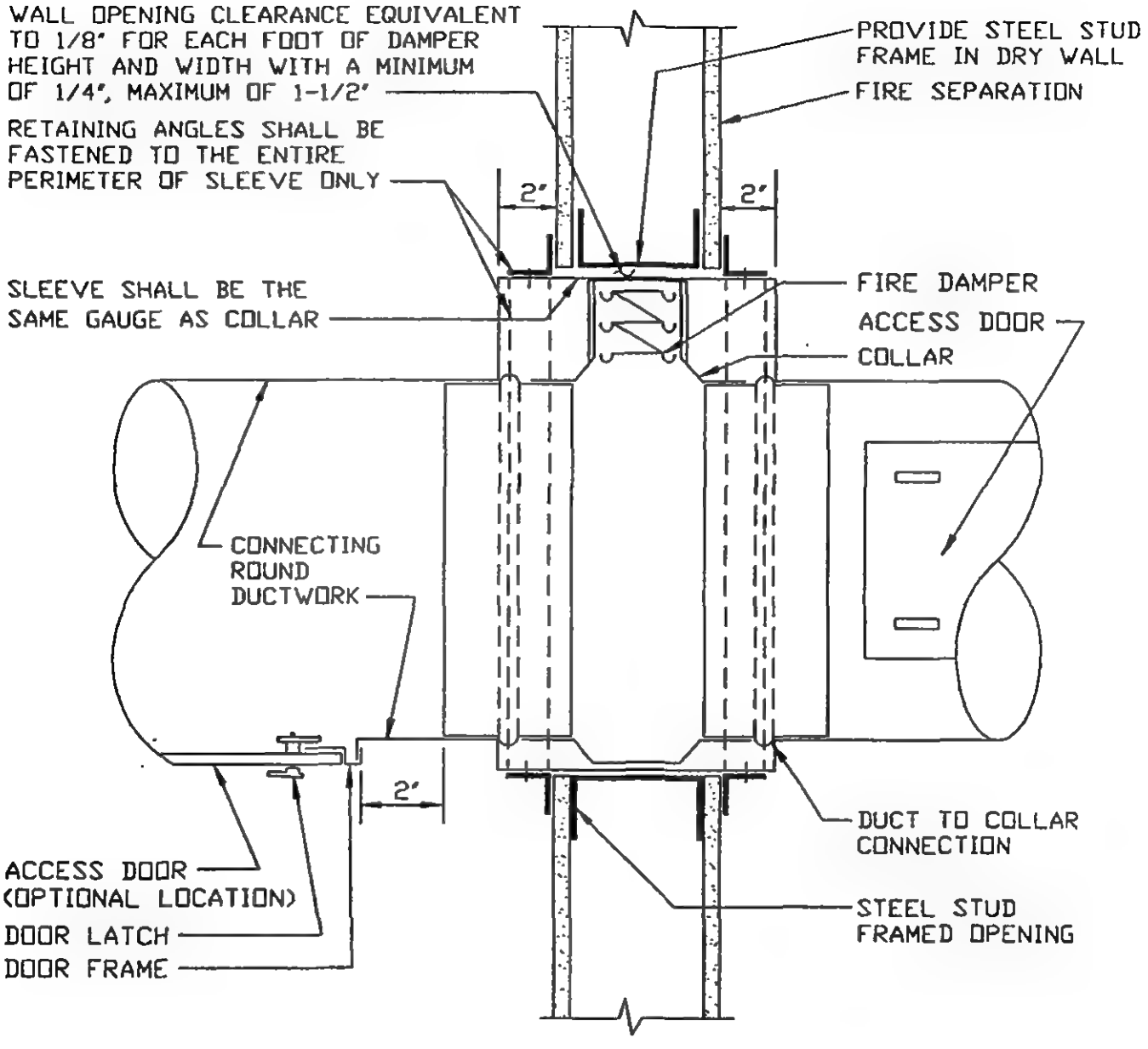


FIRE DAMPER INSTALLATION TYPE "A"
FOR TRANSFER AIR DUCT

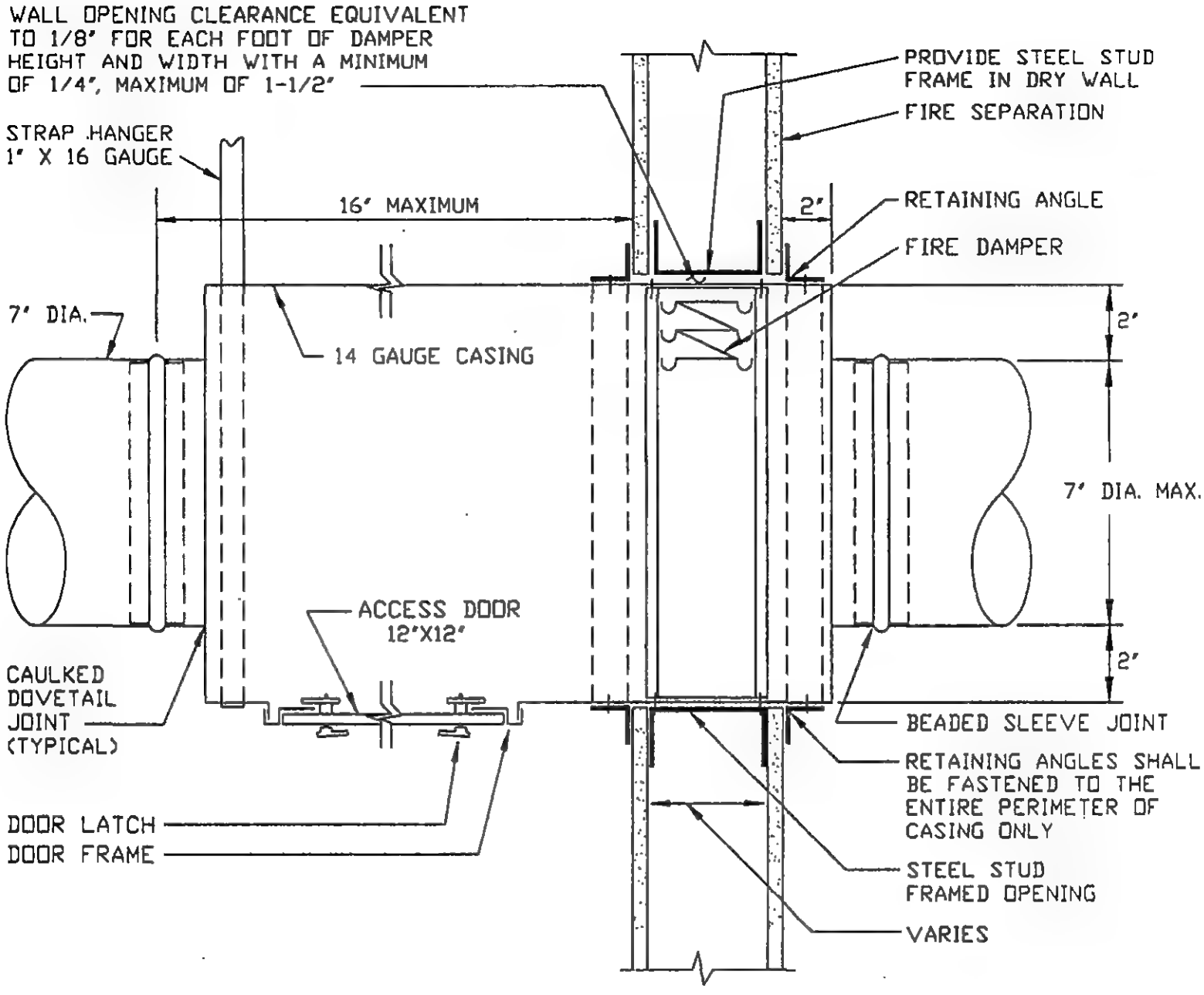


FIRE DAMPER INSTALLATION TYPE "B"

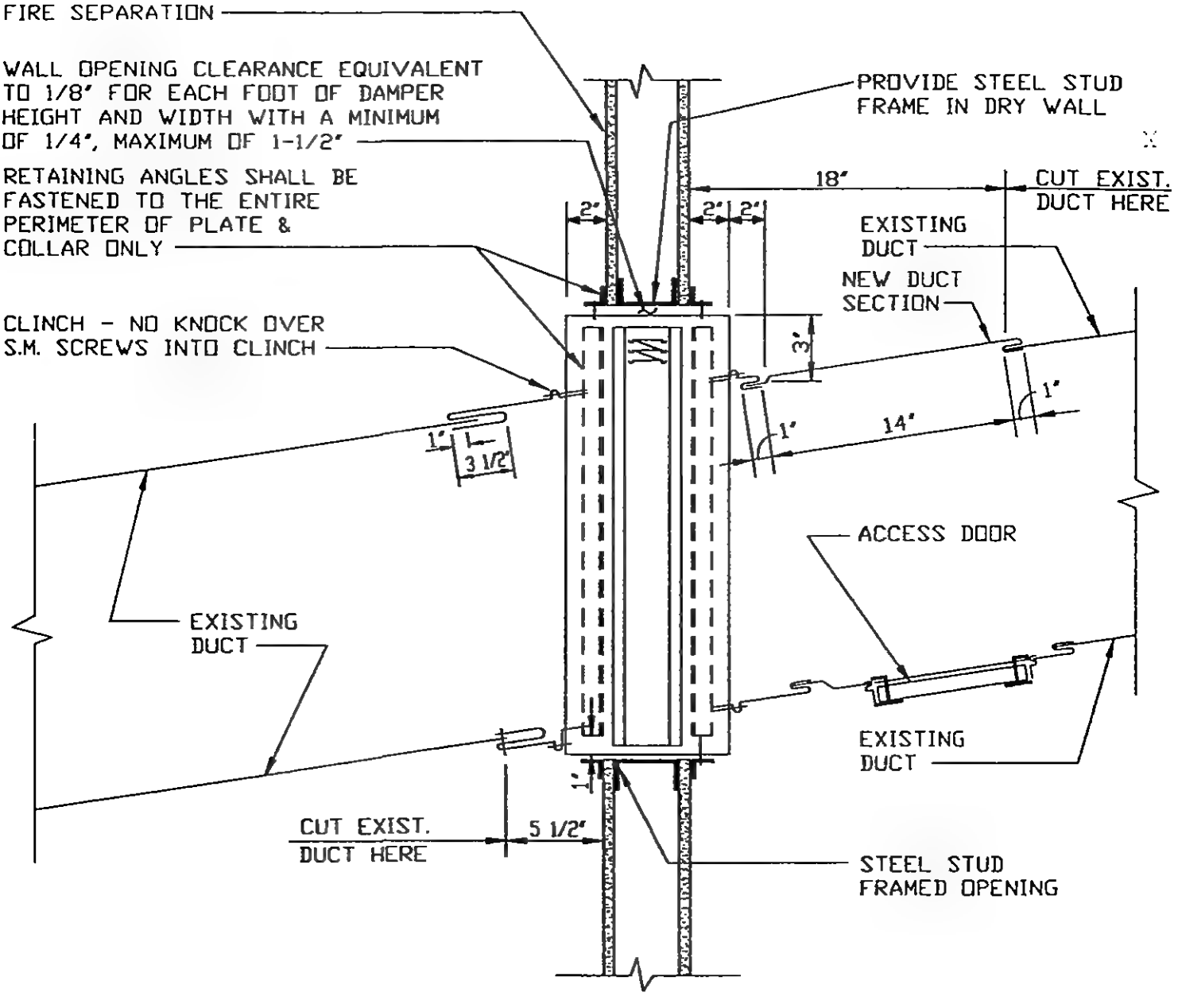
FOR MAIN OR BRANCH DUCT



FIRE DAMPER INSTALLATION TYPE "C" FOR PERIPHERAL SUPPLY DUCT (HIGH PRESSURE)

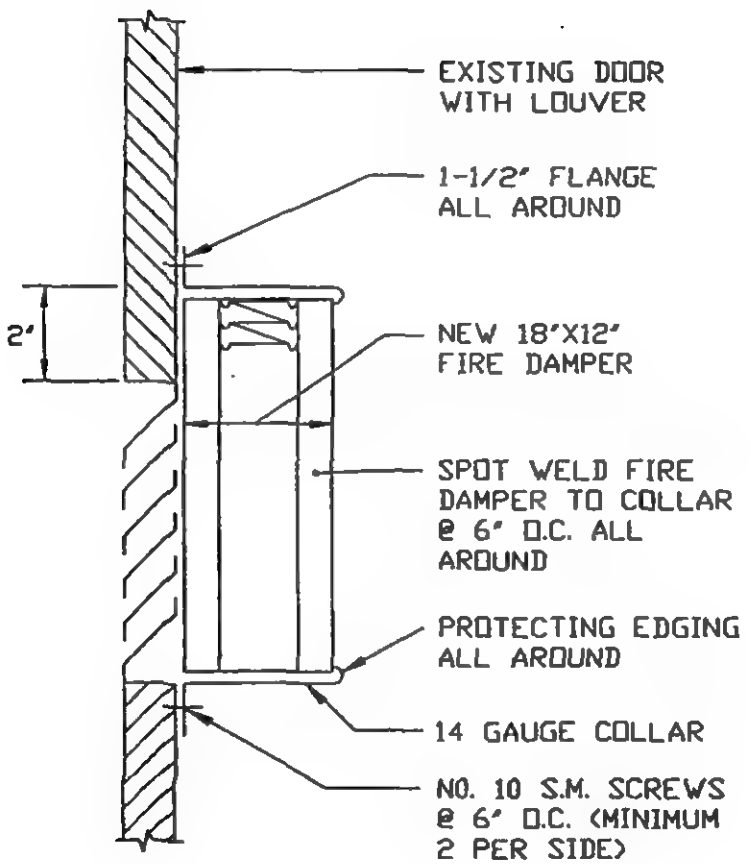


FIRE DAMPER INSTALLATION TYPE "D"
FOR FINGER ROUND DUCT

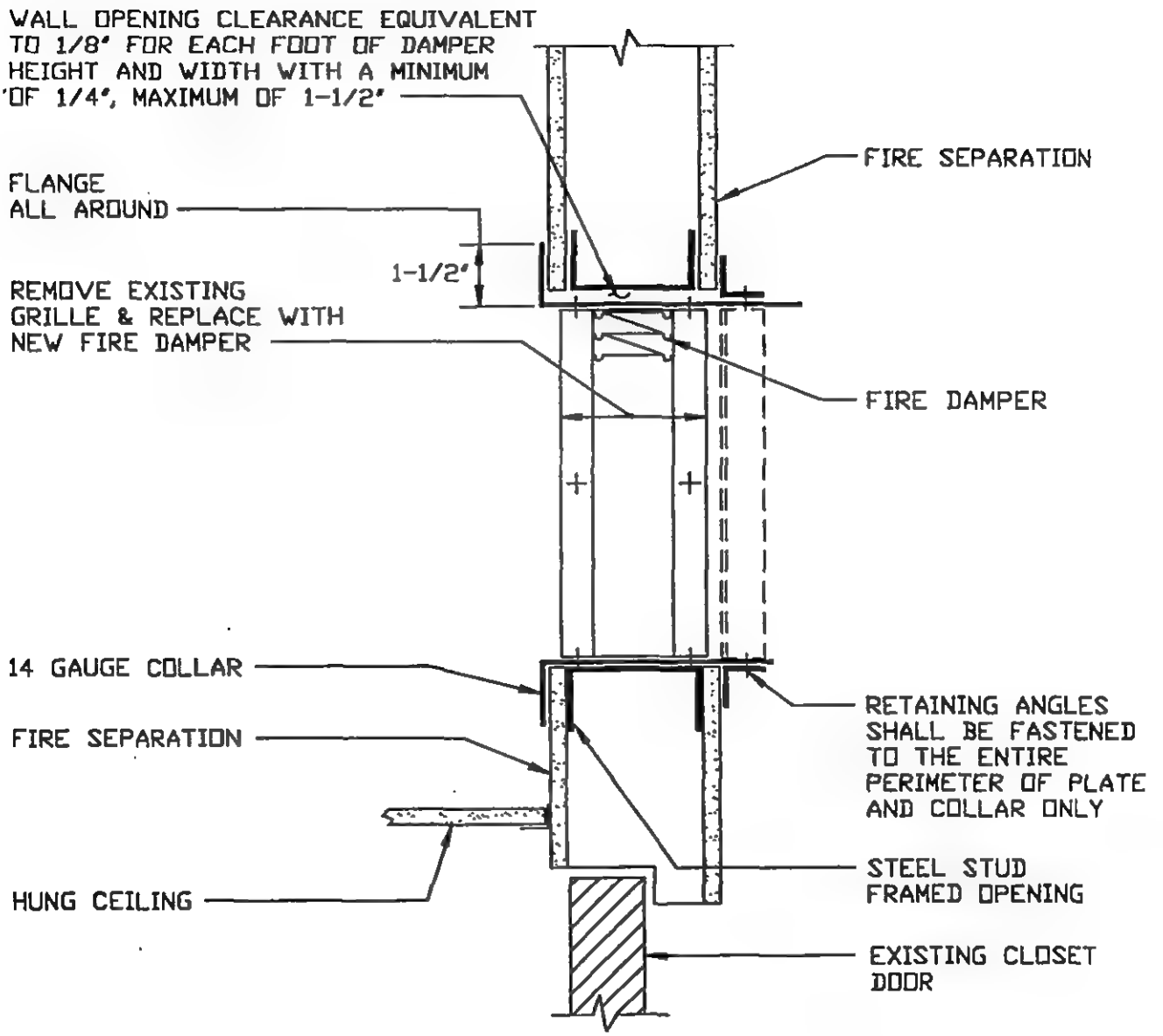


FIRE DAMPER INSTALLATION TYPE "E"

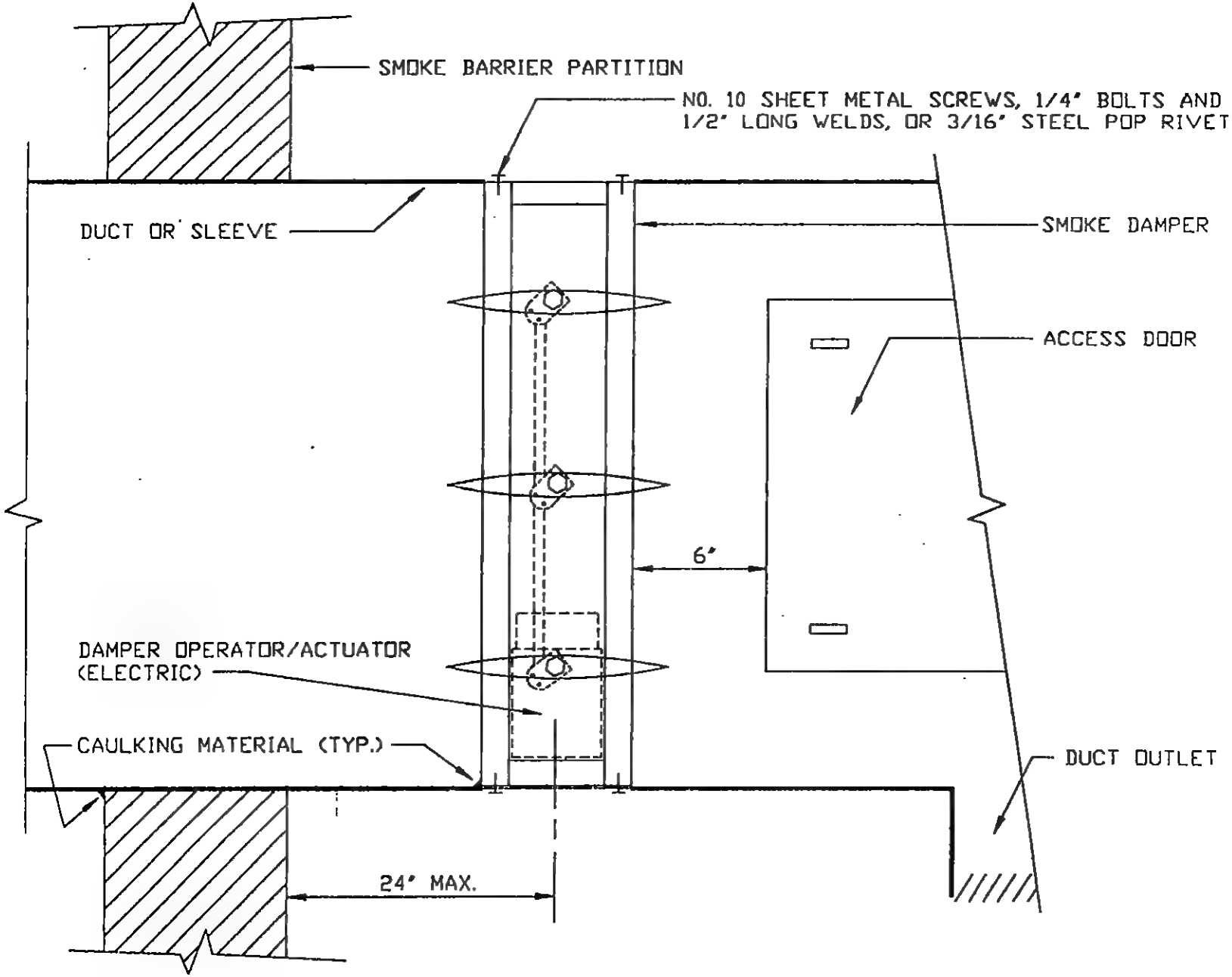
FOR BRANCH DUCT ON A SKEW



FIRE DAMPER INSTALLATION TYPE "F"
FOR LOUVERED DOOR

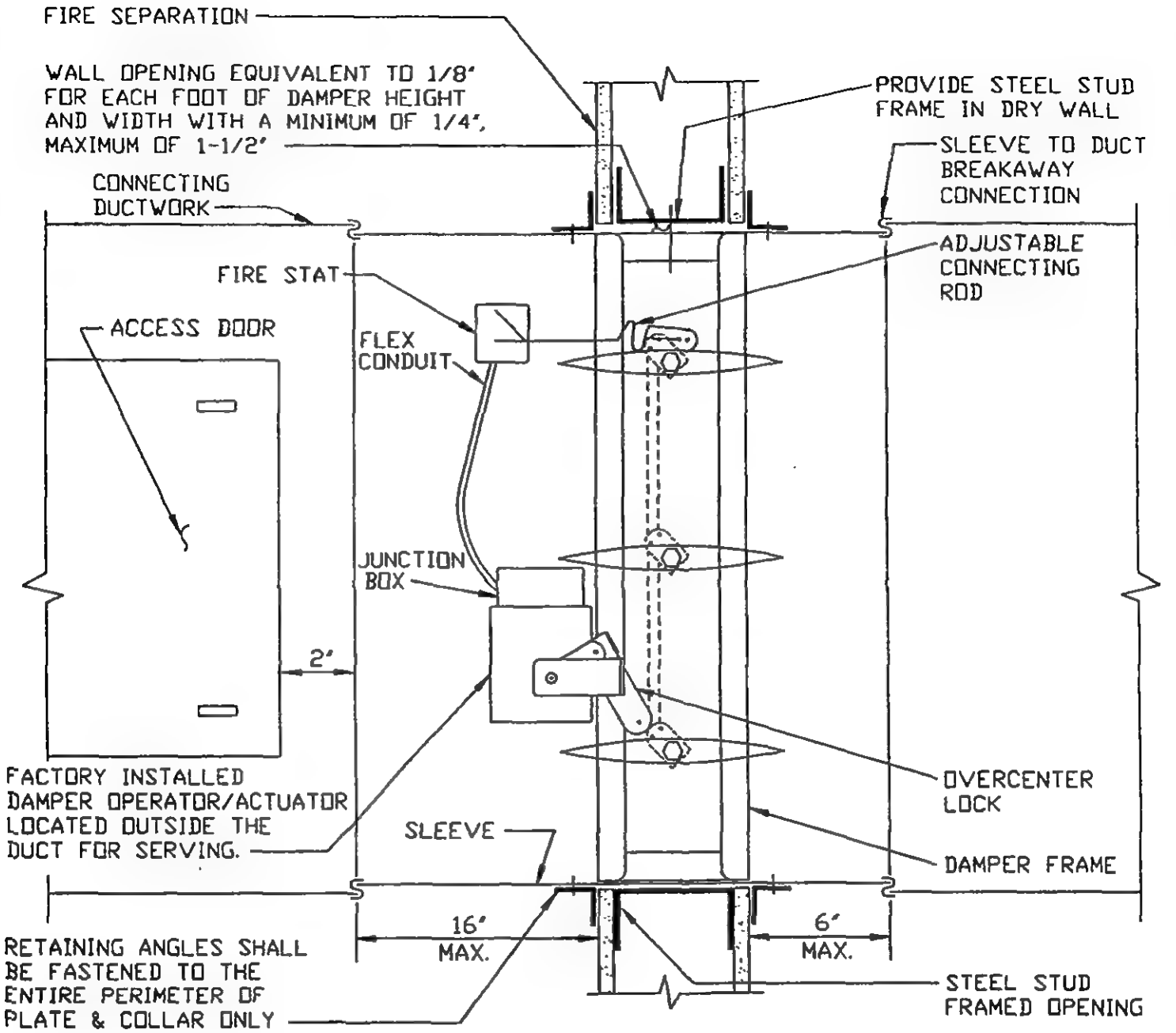


INSTALLATION TYPE "G" FOR FIRE DAMPER ABOVE CLOSET/LOUVERED DOOR



SMOKE DAMPER INSTALLATION DETAIL

NOT TO SCALE

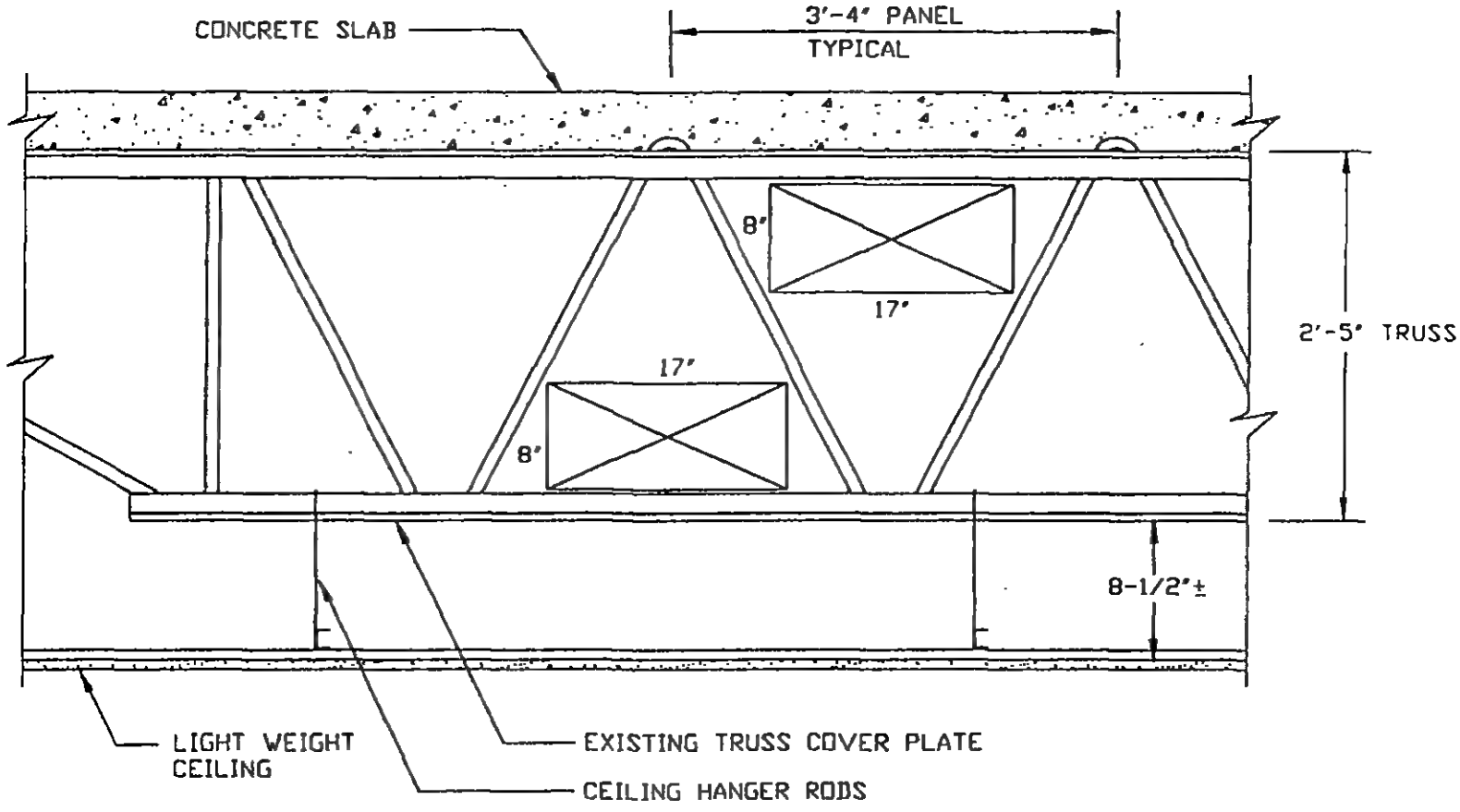


INSTALLATION DETAIL FOR COMBINATION FIRE AND SMOKE DAMPER

NOTE: ROUNDS DUCTS MUST USE A 4" WIDE DRAWBAND CONNECTION. REFER TO MANUFACTURE OPERATION INSTRUCTION FOR REQUIREMENTS ON VARIOUS TRANSITION CONNECTIONS.

ACCESS DOOR SIZES (IN INCHES)														
DUCT WIDTH		8	10	12	14	16	20	24	28	32	36	40	44	48
DUCT HEIGHT	8	10X8	10X8	10X8	10X8	10X8	10X8	10X8	12X10	12X10				
	10		10X8	10X8	10X8	10X8	10X8	10X8	12X12	12X12	12X12	14X12		
	12			12X10	12X10	12X10	12X10	12X10	14X12	14X12	14X12	14X14	14X14	14X14
	14				12X12	12X12	12X12	12X12	14X12	14X12	14X12	14X14	14X14	14X14
	16					14X12	14X12	14X12	14X12	14X12	14X12	14X14	14X14	14X14
	20						14X12	14X12	14X12	14X12	14X12	16X14	16X14	16X14
	24							14X14	14X14	14X14	14X14	16X16	16X16	16X16

ACCESS DOOR SCHEDULE

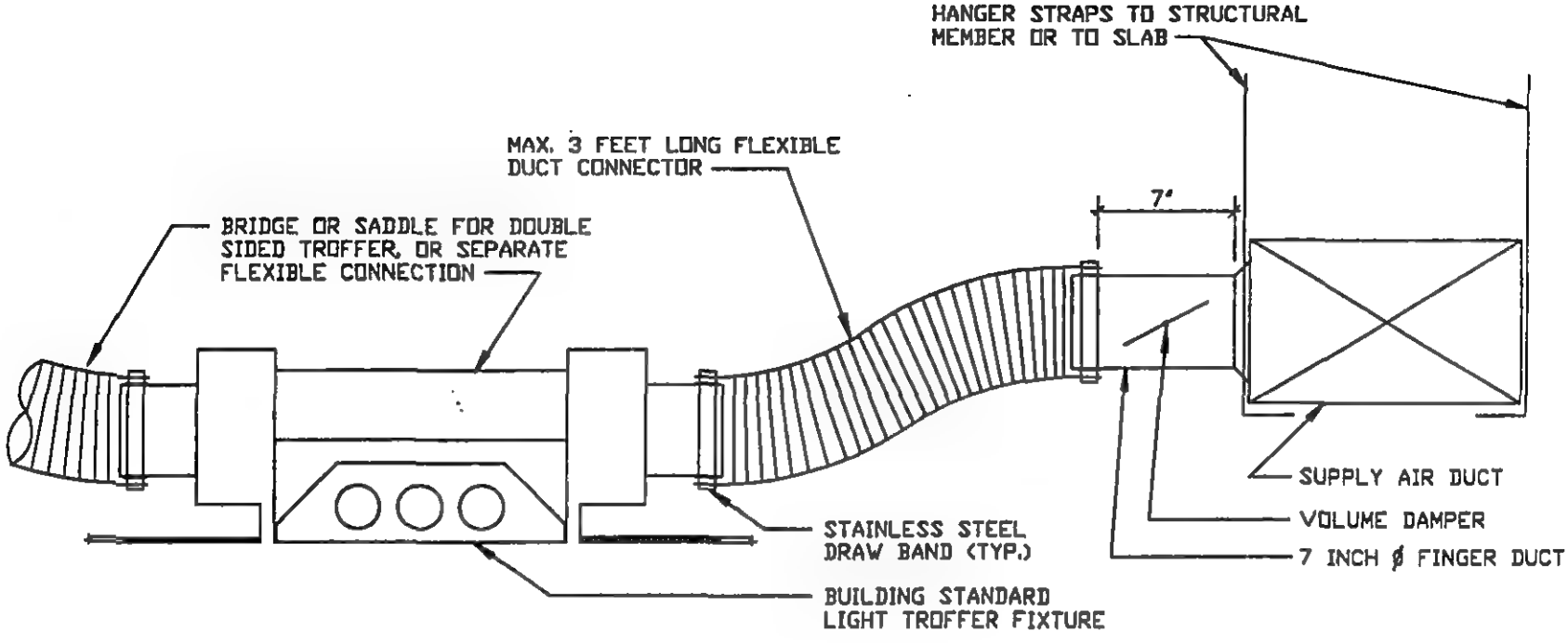


DETAIL OF DUCT IN TRUSSES

NOT TO SCALE

NOTES:

1. MAXIMUM DUCT SIZE THROUGH TRUSS IS 17" X 8".
2. THIS DETAIL APPLIES TO 1 WTC. AND 2 WTC. TOWER FLOORS ONLY.



LIGHT TROFFER AIR DIFFUSER CONNECTION

NOT TO SCALE

NOTE: FLEXIBLE CONNECTIONS TO THE SUPPLY DUCT AND THE DIFFUSER PLENUM OF CEILING POUCHES SHALL BE SEALED WITH 3M CO. 800 SEALANT AND CLAMPED WITH STAINLESS STEEL IDEAL TYPE 52 CLAMPS.

INDUCTION UNIT REPLACEMENT SCHEDULE

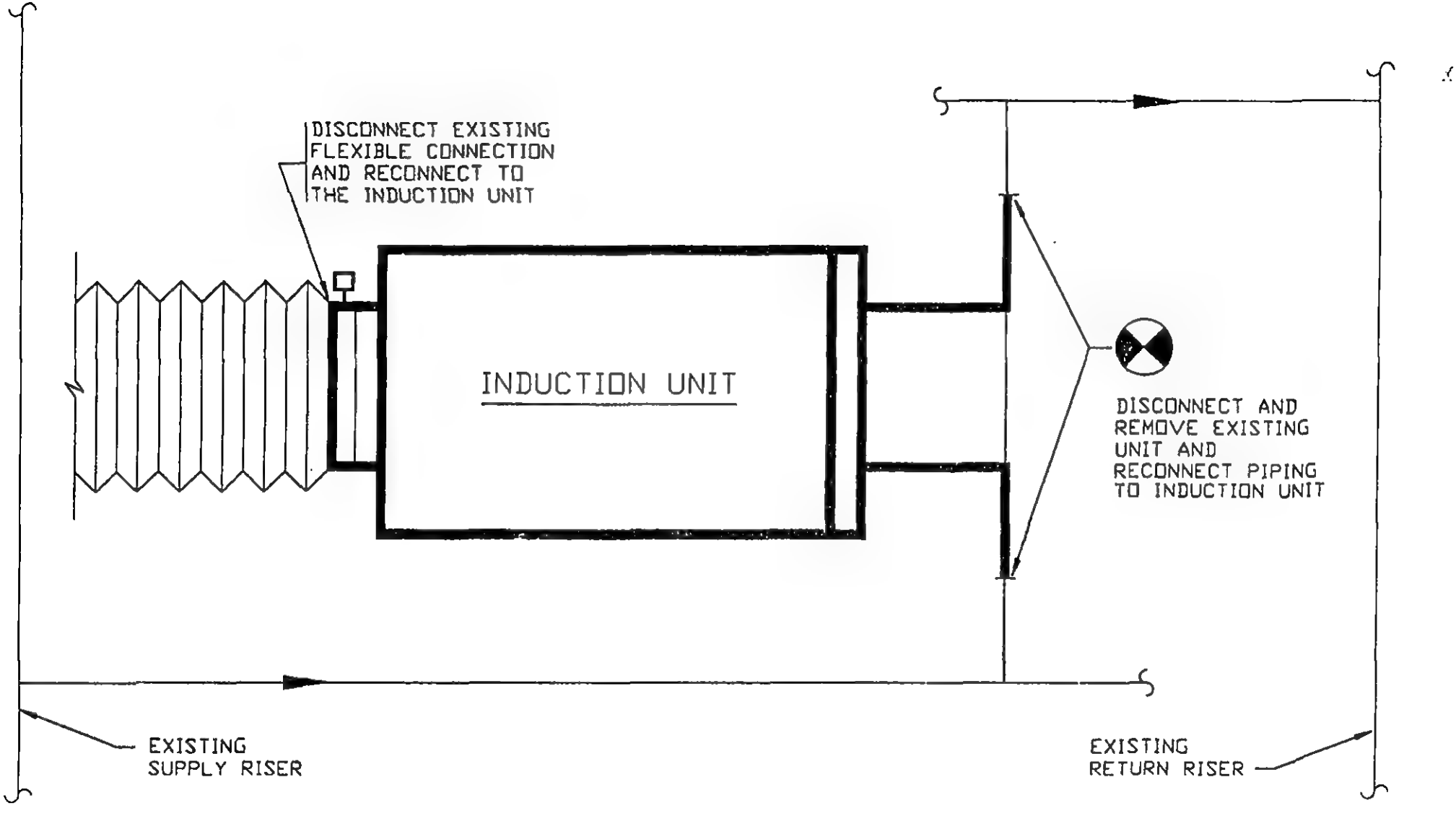
Base Building Design Type	Primary Air CFM	Cooling Btuh	Heating Btuh	Carrier Model	Remarks
1	50	3620	2580	36SL20JL31	West Exp.
2	35	1535	2160	36SL10KL31	N & W Corners
3	50	2460	2980	36SL10KL31	North Exp.
4	60	4220	2580	36SL20HR31	South & East
5	40	1950	2160	36SL10KL31	S & E Corners
6T	90	6450	7560	36SL60HR31	1-1/2 cap. of S&E Type 4
7T	65	5050	3350	36SL40HR31	1-/1/2 cap.of West Type 1
9T	50	3620	2580	36SL20JL31	1-1/2 cap. of North Type 3

Notes:

1. The units are either right-hand side (R) or left-hand side (L) coil connection.

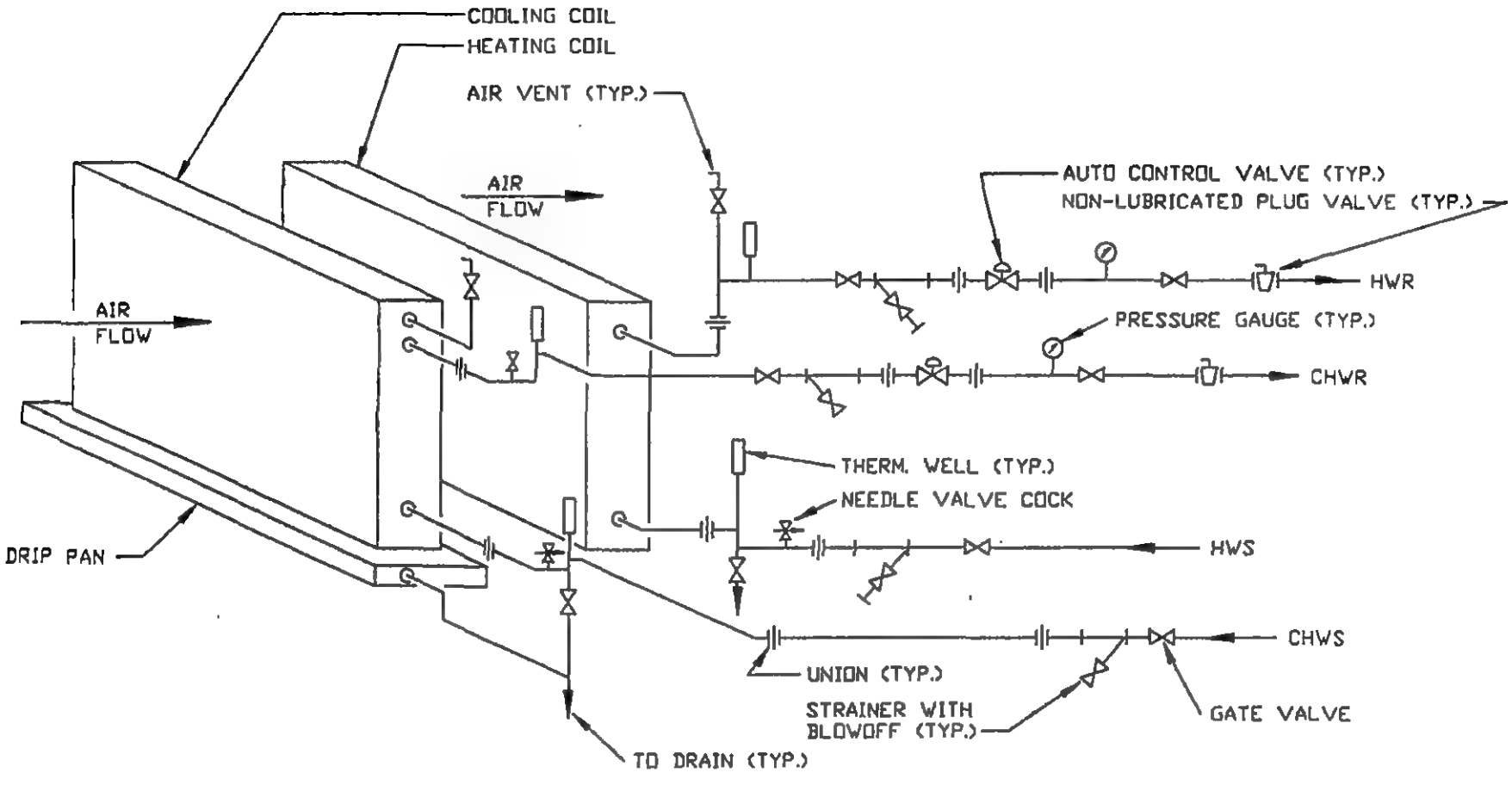
2. The above chart is for typical floors in Tower A & B only. Typical floors are: 9-39, 45-66, 68-73, 77, 79-105. Refer to base building drawings for floors 40, 43, 44, 67 (Tower A only), 74, 78, 106, and 107. The Engineer shall verify in the field for existing installation.

3. The above listed induction units are made by Carrier Corp. for World Trade Center use only. The Contractor shall purchase the induction units as required from the Port Authority.



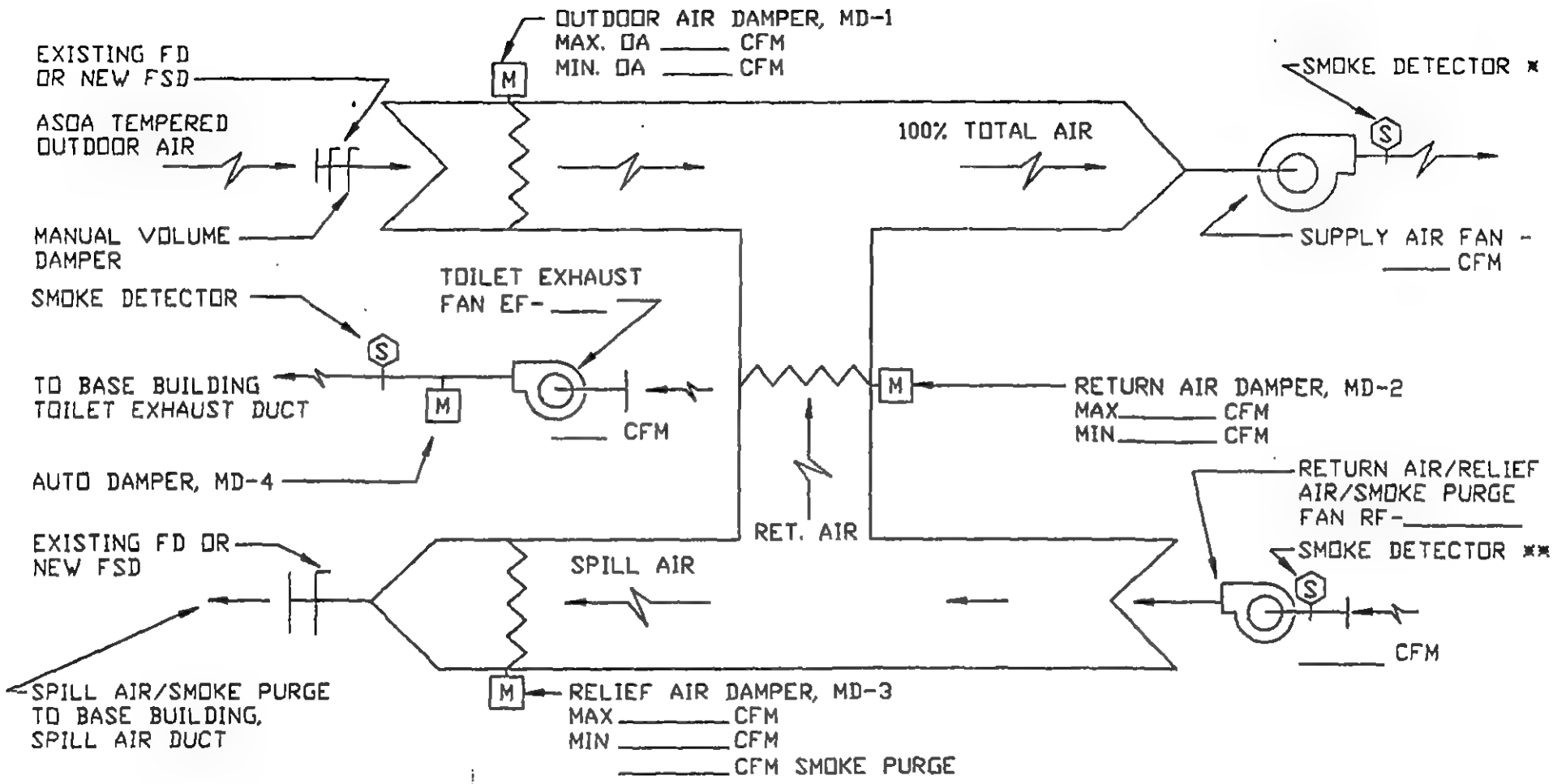
SCHEMATIC PIPING CONNECTION TO INDUCTION UNIT

N.T.S.



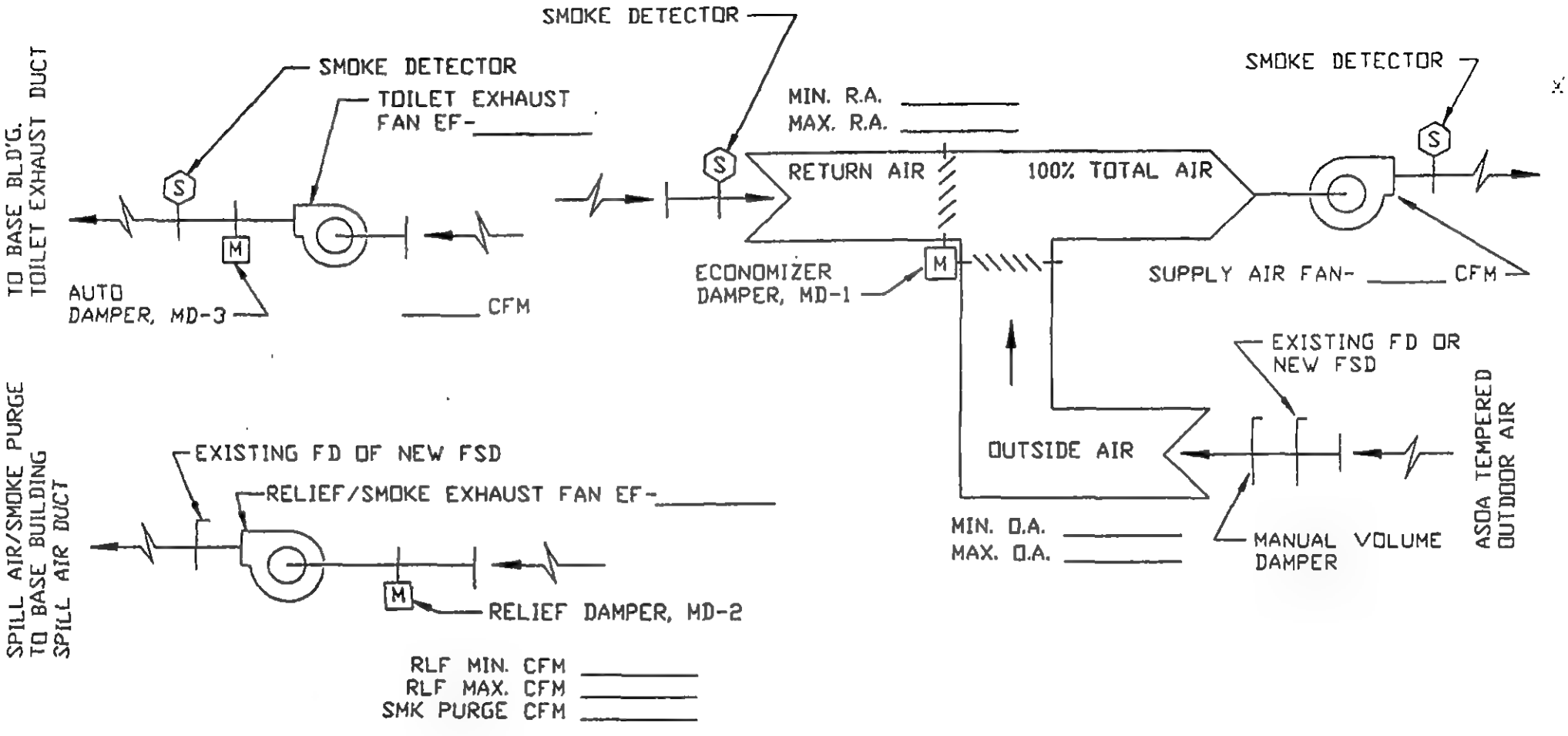
PIPING CONNECTIONS TO CHILLED WATER AND HOT WATER COILS

NOT TO SCALE

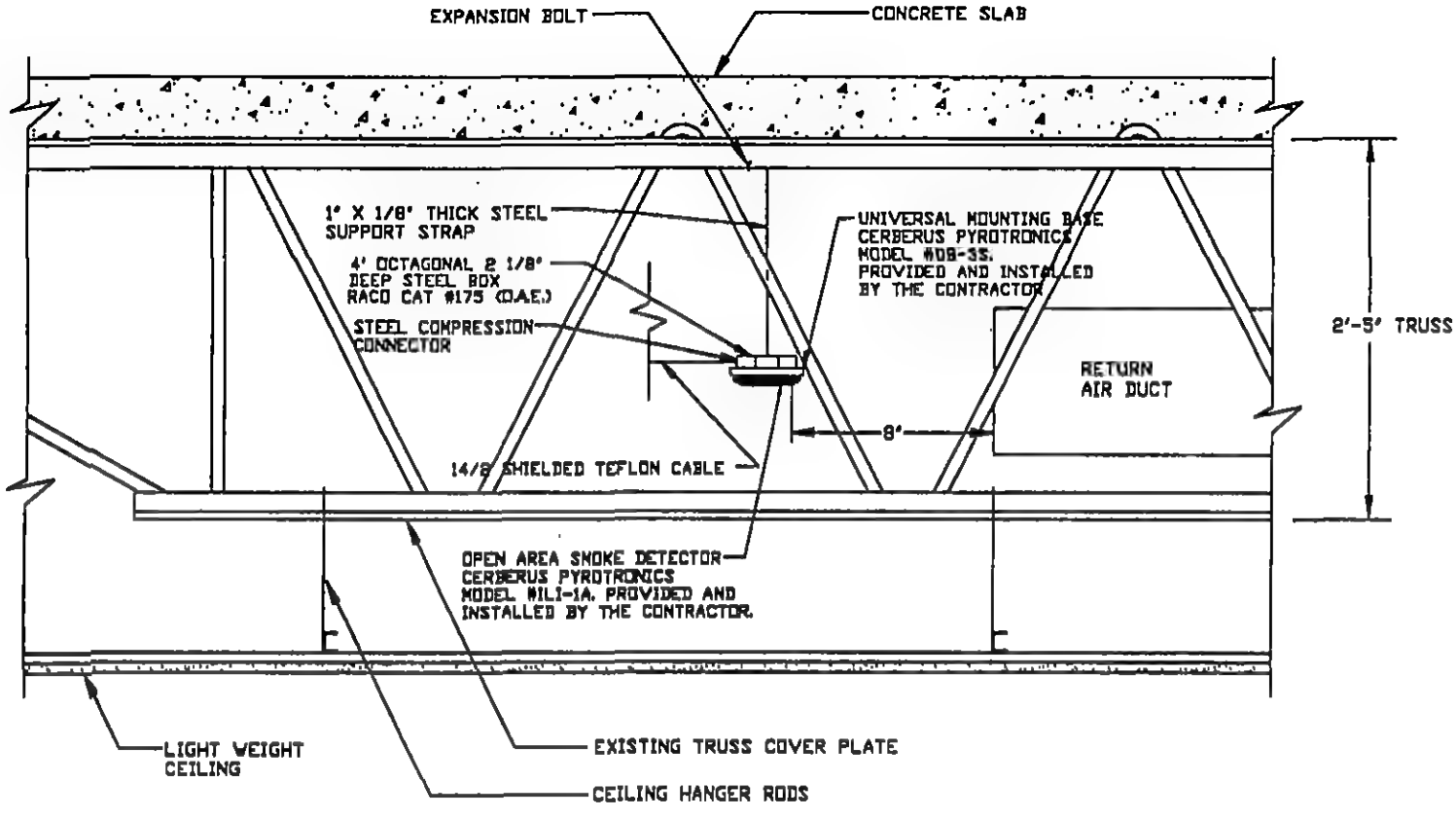


* FOR ALL SIZES
** FOR SYSTEM OVER 15,000 CFM

AIR BALANCING SCHEDULE/AIR FLOW DIAGRAM-1

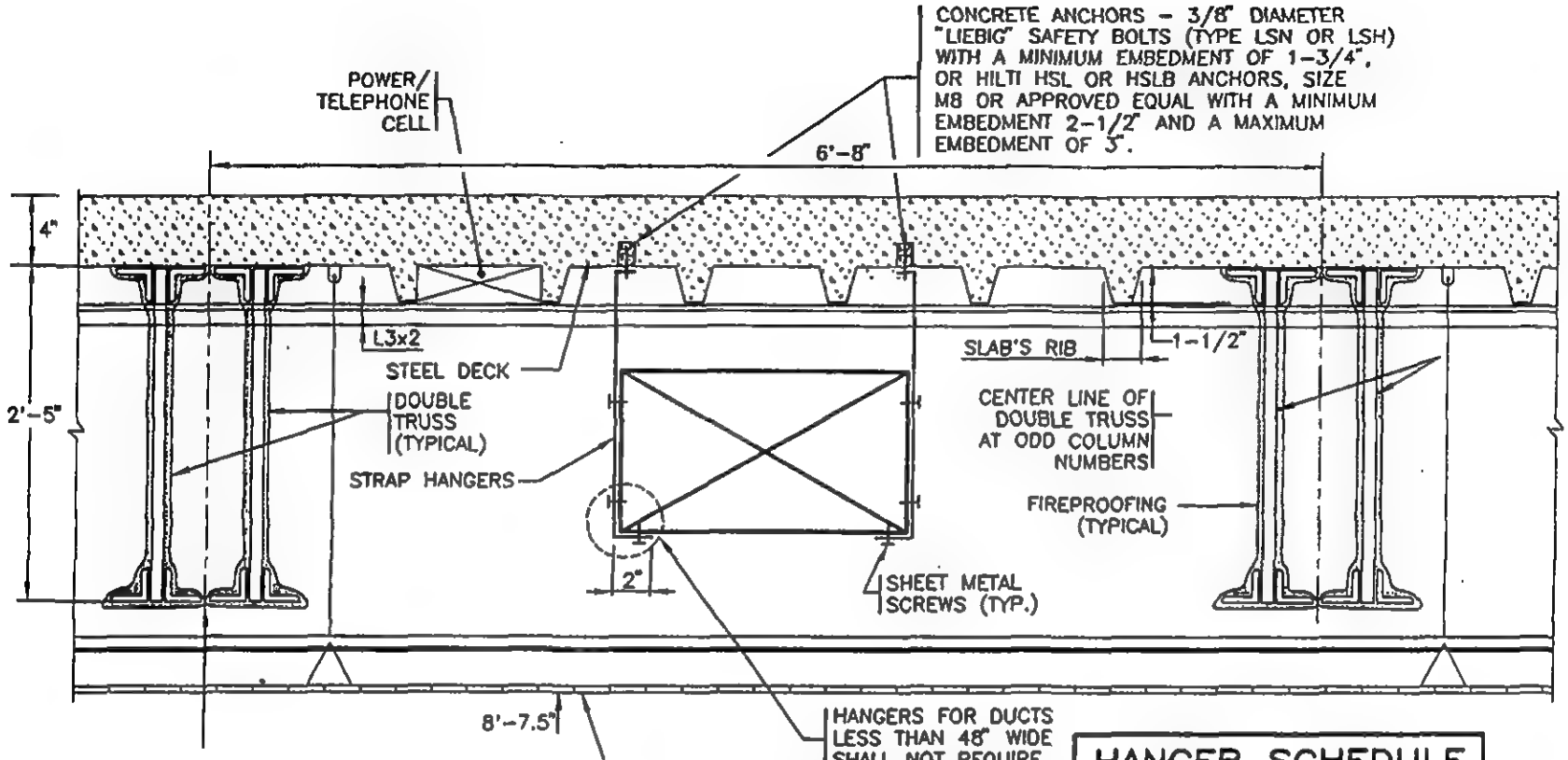


AIR BALANCE SCHEDULE/AIR FLOW DIAGRAM-2



SMOKE DETECTOR INSTALLATION AT RETURN AIR DUCT

NOT TO SCALE



NOTES:

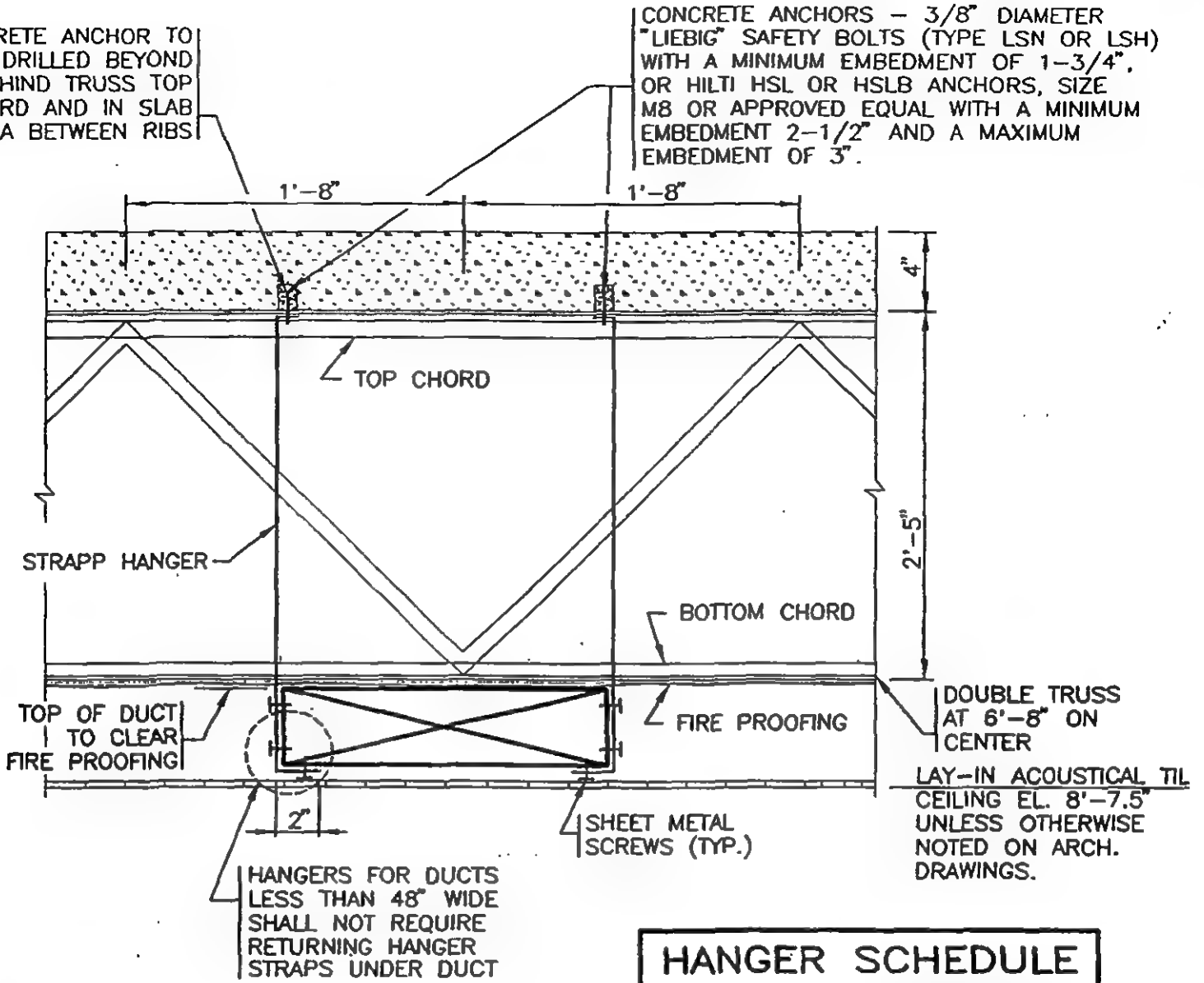
1. LOAD IN METAL HANGERS SHALL NOT EXCEED 50 LBS.
2. INSPECT EXISTING TABS AND USE THEM IN LIEU OF EXPANSION BOLTS WHERE POSSIBLE.
3. DO NOT HANG DUCTS FROM POWER/TELEPHONE CELLS.
4. ANCHORS SHALL NOT BE INSTALLED WITHIN THE SLAB'S RIB.

HANGER SCHEDULE

DUCT SIZE	STRAP HANGER	
	SIZE	SPACING
< 2 SQ. FT.	1"x1/16"	8'–0"
2 TO 4 SQ. FT.	1"x1/8"	8'–0"
4 TO 10 SQ. FT.	1"x1/8"	6'–0"
> 10 SQ. FT.	1"x1/8"	4'–0"

DUCT HANGING DETAIL – TYPE "A"
FOR DUCT RUNNING PARALLEL TO DOUBLE TRUSS

N.T.S.



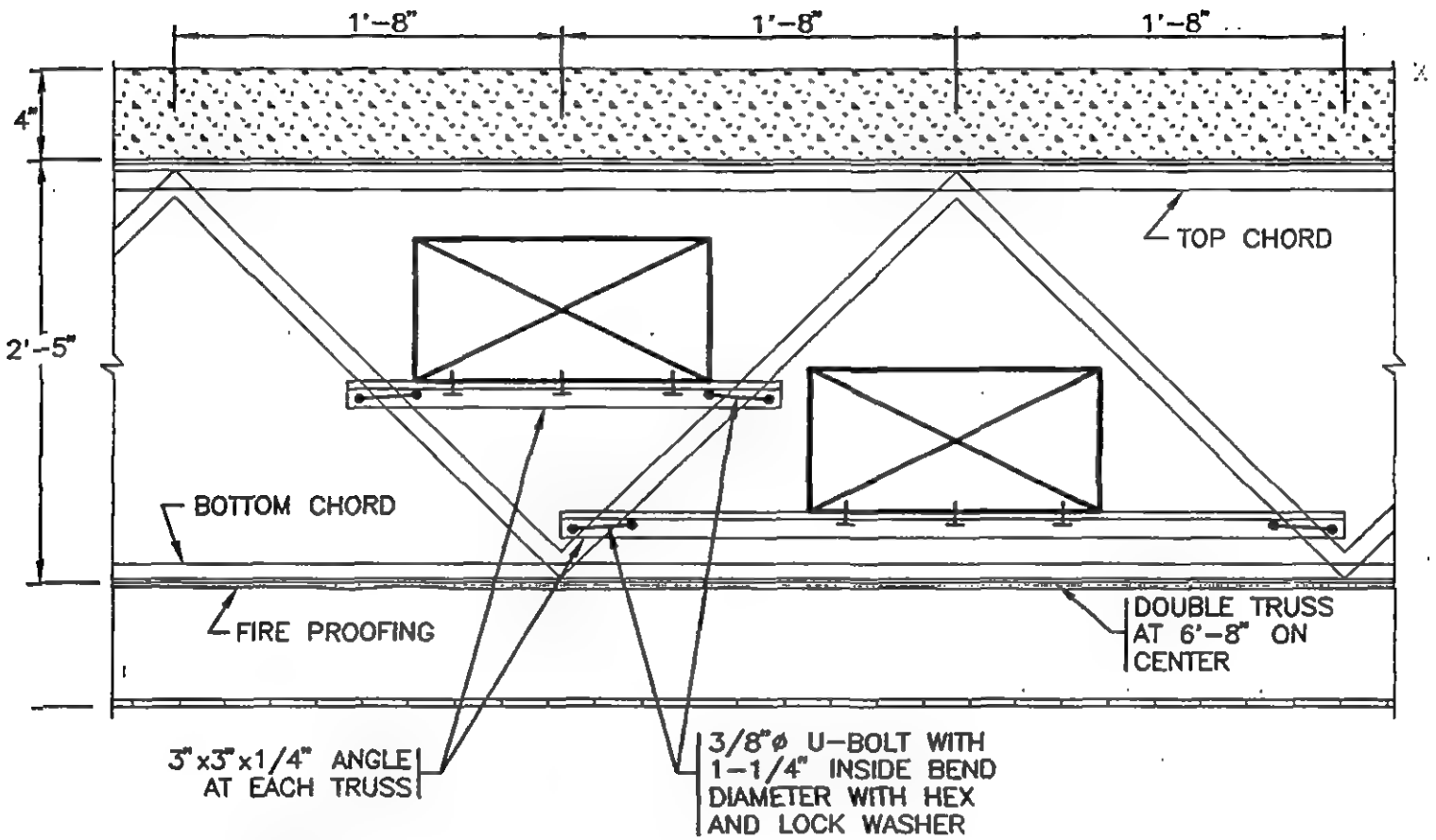
HANGER SCHEDULE		
DUCT SIZE	STRAP HANGER	
	SIZE	SPACING
< 2 SQ. FT.	1"x1/16"	8'–0"
2 TO 4 SQ. FT.	1"x1/8"	8'–0"
4 TO 10 SQ. FT.	1"x1/8"	6'–0"
>10 SQ. FT.	1"x1/8"	4'–0"

NOTES:

1. LOAD IN METAL HANGERS SHALL NOT EXCEED 50 LBS.
2. INSPECT EXISTING TABS AND USE THEM IN LIEU OF EXPANSION BOLTS WHERE POSSIBLE.
3. DO NOT HANG DUCTS FROM POWER/TELEPHONE CELLS.

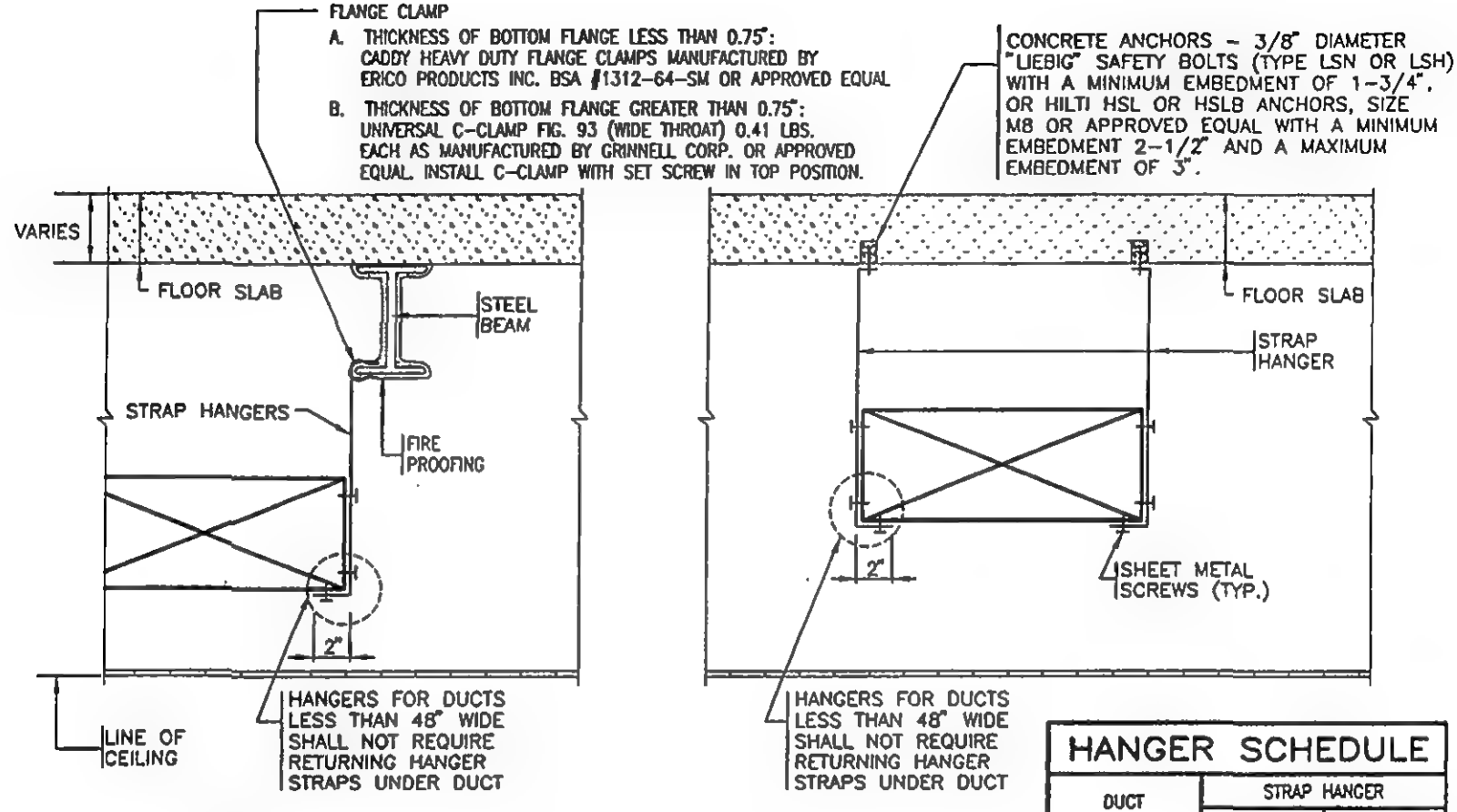
DUCT HANGING DETAIL – TYPE "B" FOR DUCT RUNNING PERPENDICULAR TO DOUBLE TRUSS AT AN ELEVATION BELOW THE BOTTOM CHORD

N.T.S.



DUCT HANGING DETAIL – TYPE "C"
FOR DUCT RUNNING PERPENDICULAR TO DOUBLE TRUS AT AN ELEVATION THRU THE TRUSS SECTION

N.T.S.



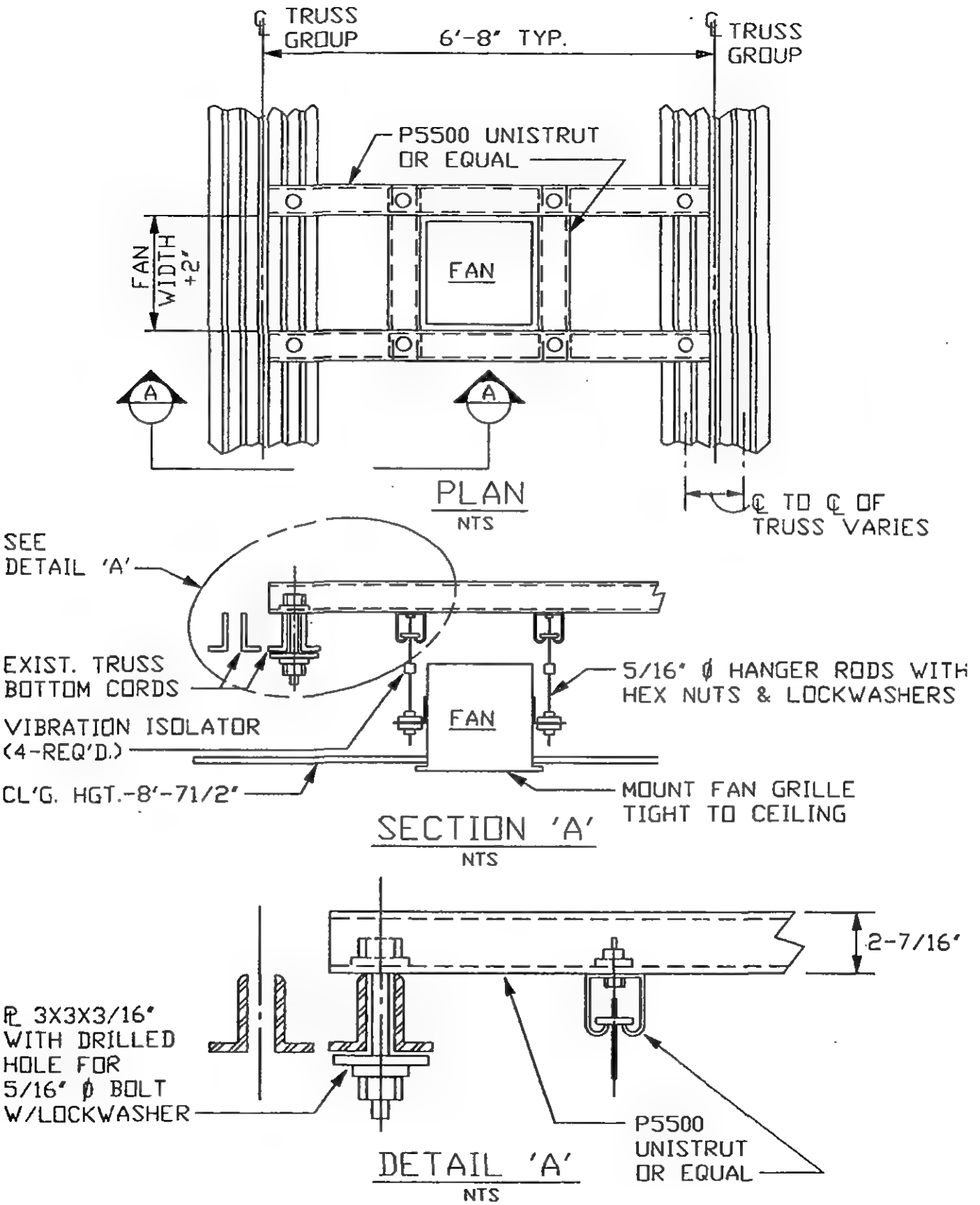
NOTES:

1. LOAD IN METAL HANGERS SHALL NOT EXCEED 50 LBS.
2. INSPECT EXISTING TABS AND USE THEM IN LIEU OF EXPANSION BOLTS WHERE POSSIBLE.
3. DO NOT HANG DUCTS FROM POWER/TELEPHONE CELLS.

HANGER SCHEDULE		
DUCT SIZE	STRAP HANGER	
	SIZE	SPACING
< 2 SQ. FT.	1"x1/16"	8'-0"
2 TO 4 SQ. FT.	1"x1/8"	8'-0"
4 TO 10 SQ. FT.	1"x1/8"	6'-0"
> 10 SQ. FT.	1"x1/8"	4'-0"

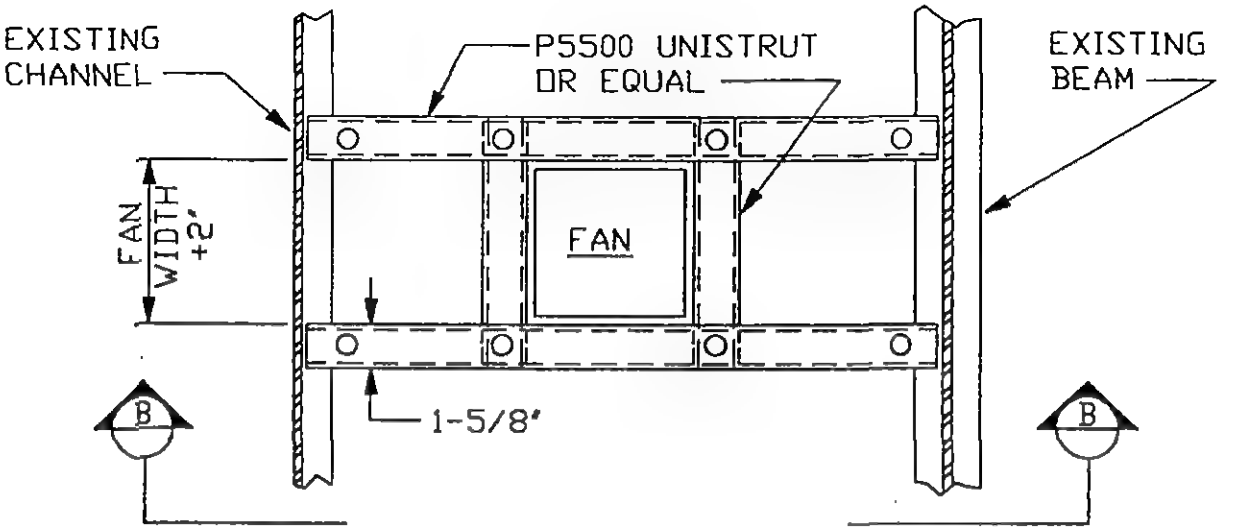
DUCT HANGING DETAILS WHERE DUCTS ARE SUPPORTED FROM CONCRETE SLAB OR STEEL BEAMS

N.T.S.

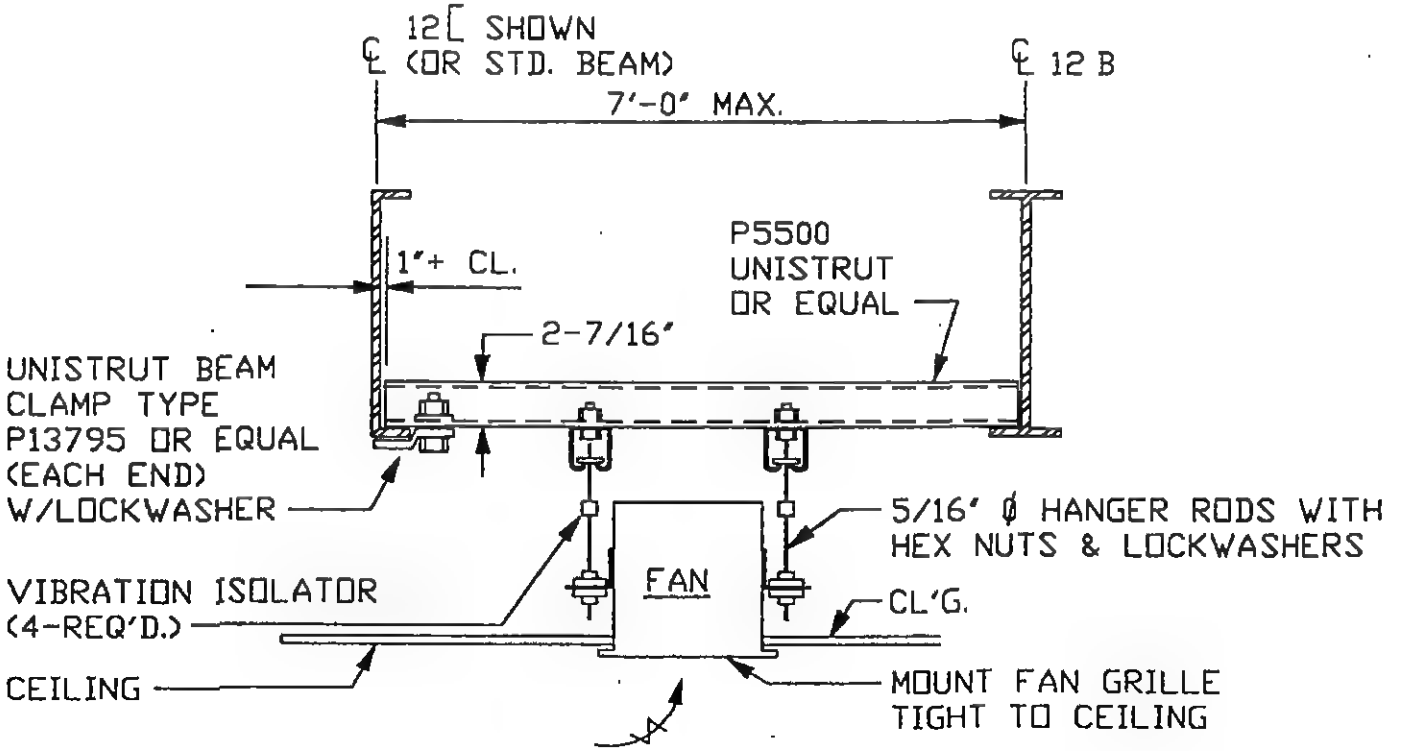


FAN HANGING DETAIL - TYPE "A"

NOT TO SCALE



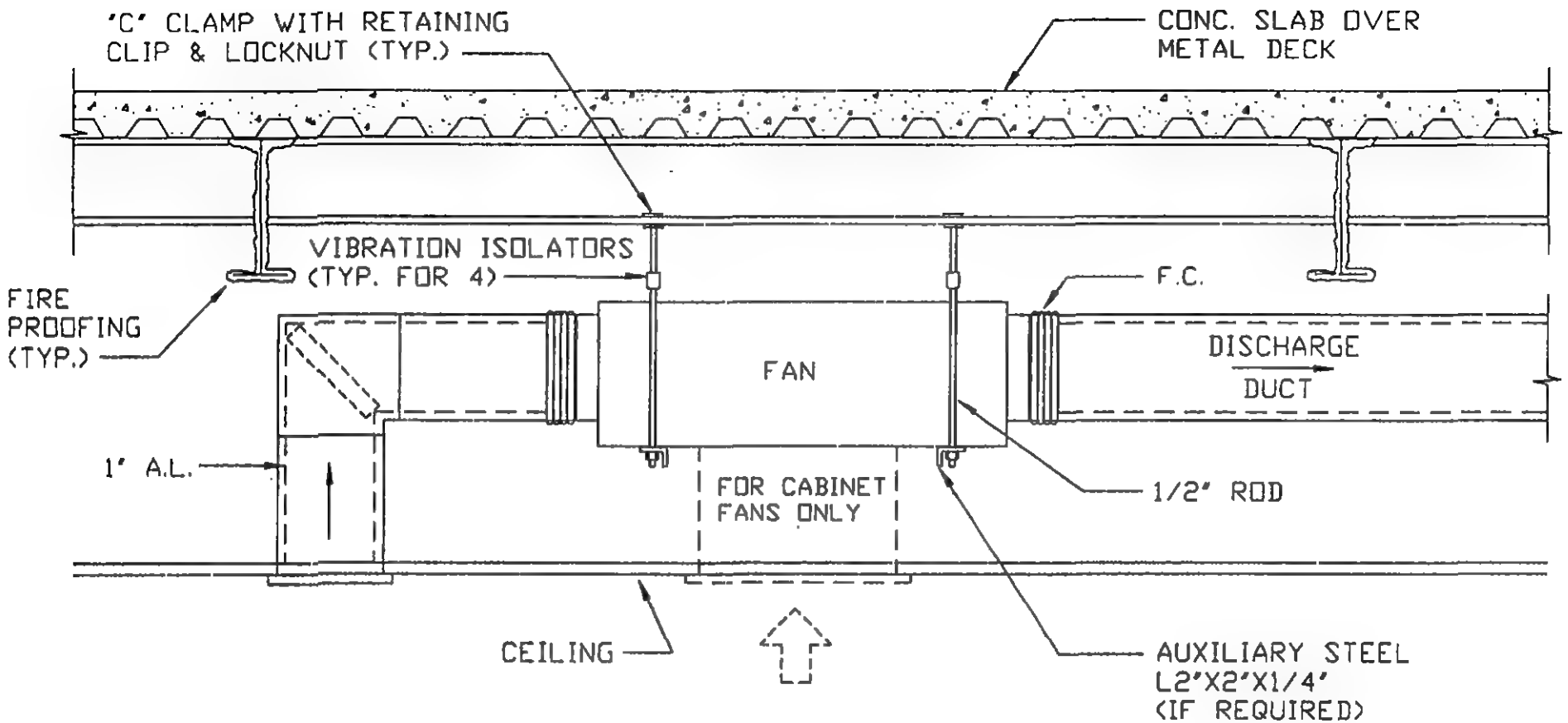
PLAN
NTS



SECTION 'B'
NTS

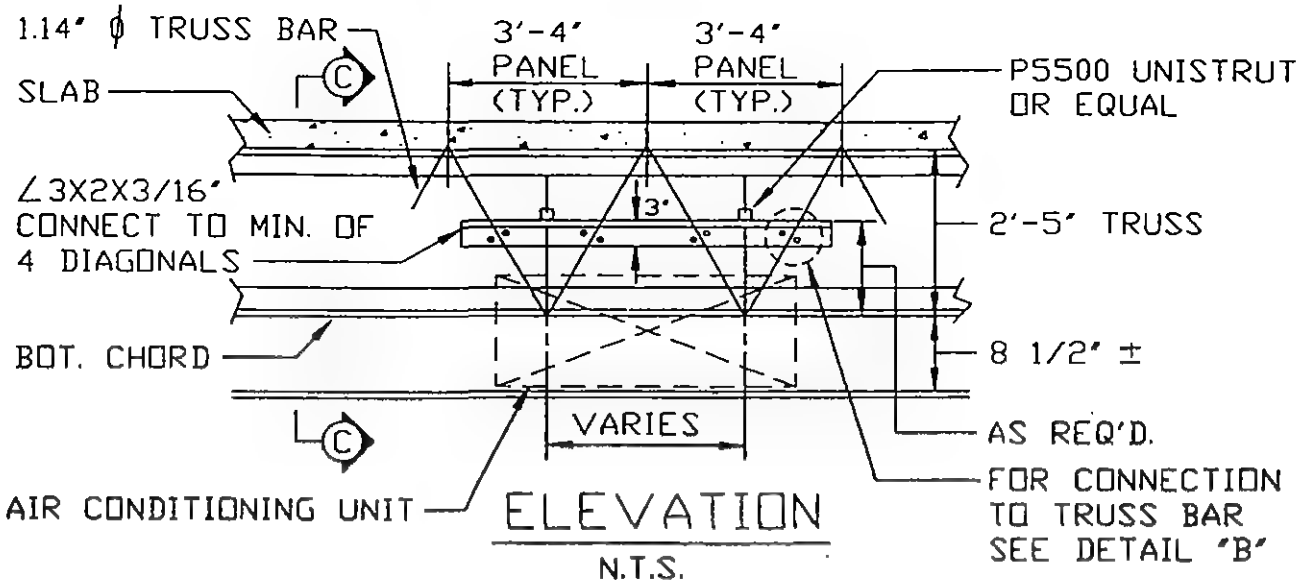
FAN HANGING DETAIL - TYPE "B"

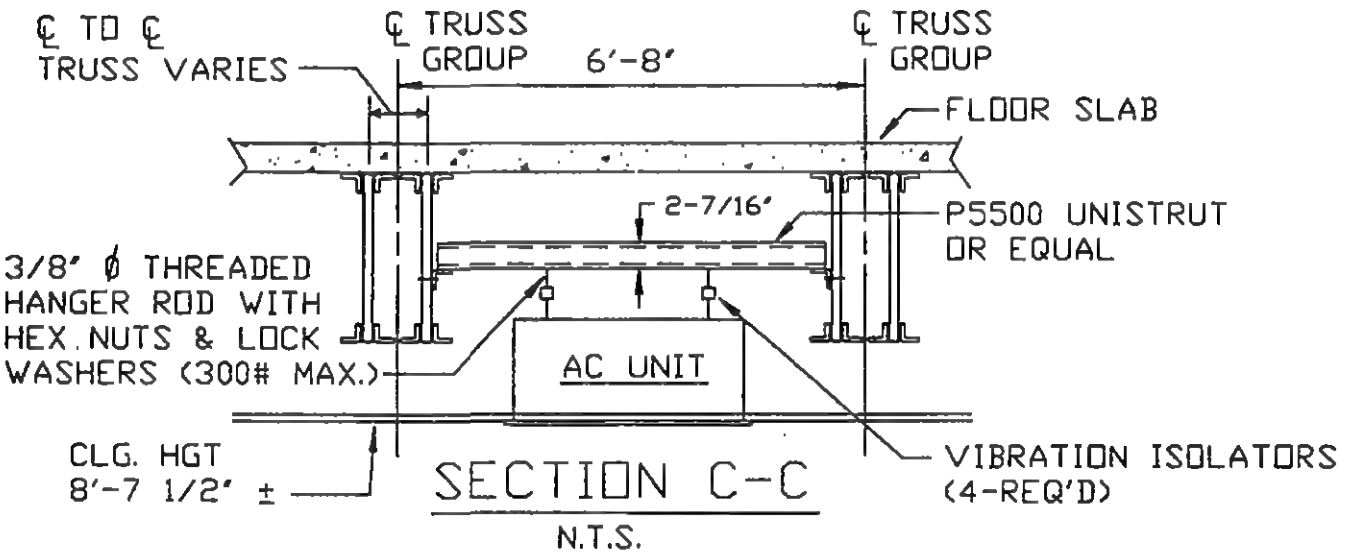
NOT TO SCALE

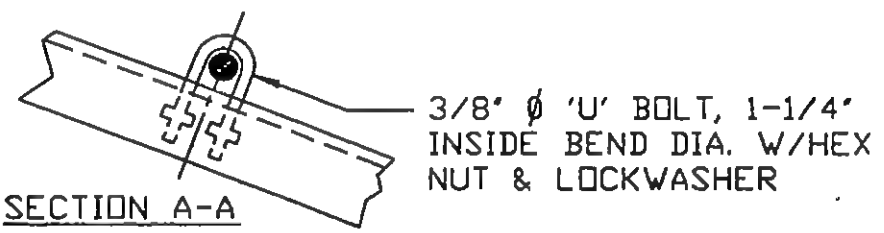


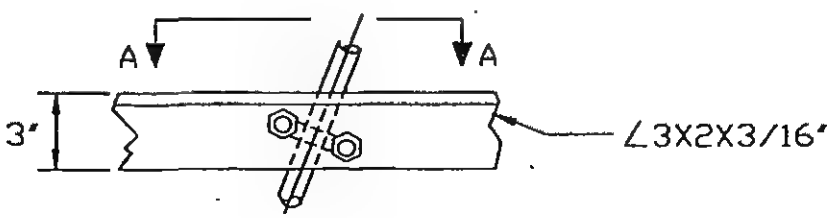
FAN HANGING DETAIL - TYPE "C"

NOT TO SCALE



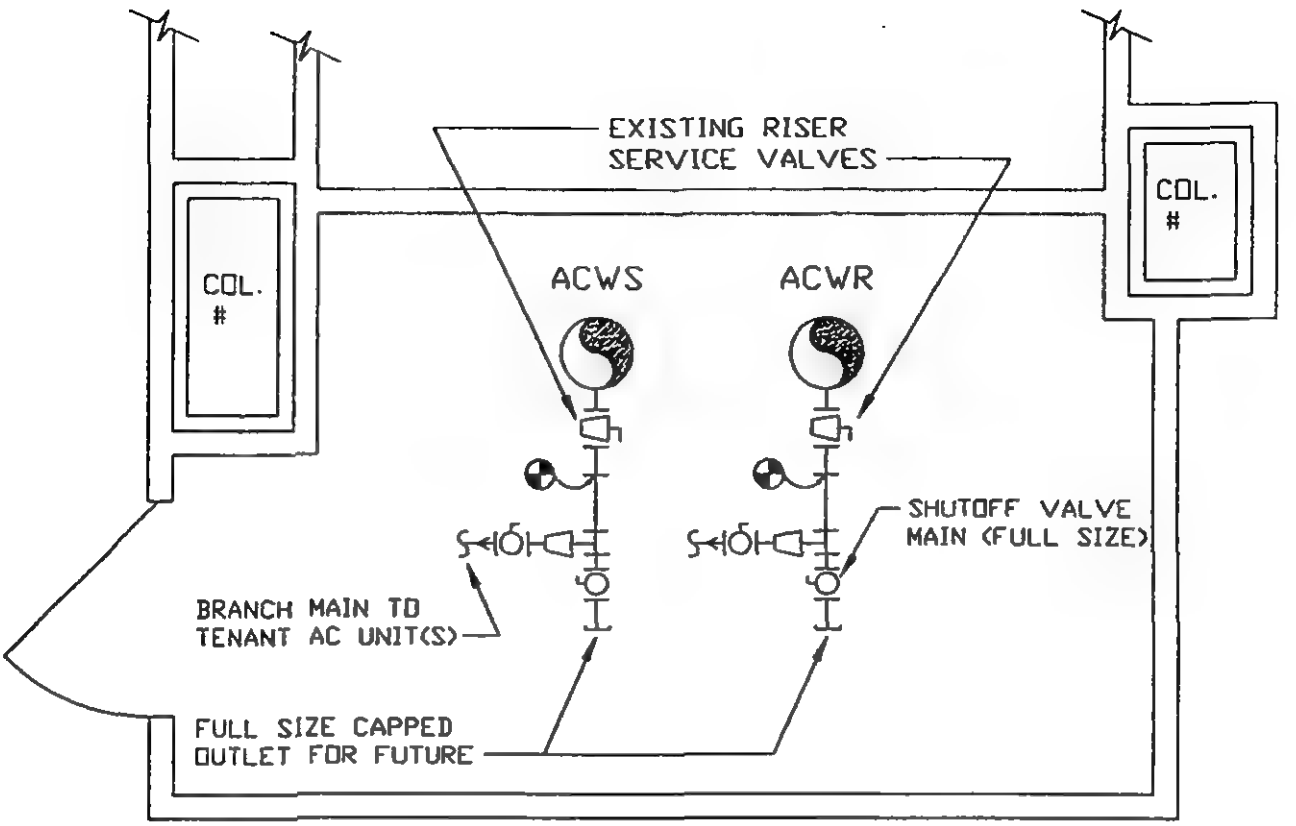






HANGING DETAIL FOR AIR CONDITIONING UNIT UNDER 500 LBS.

NOT TO SCALE



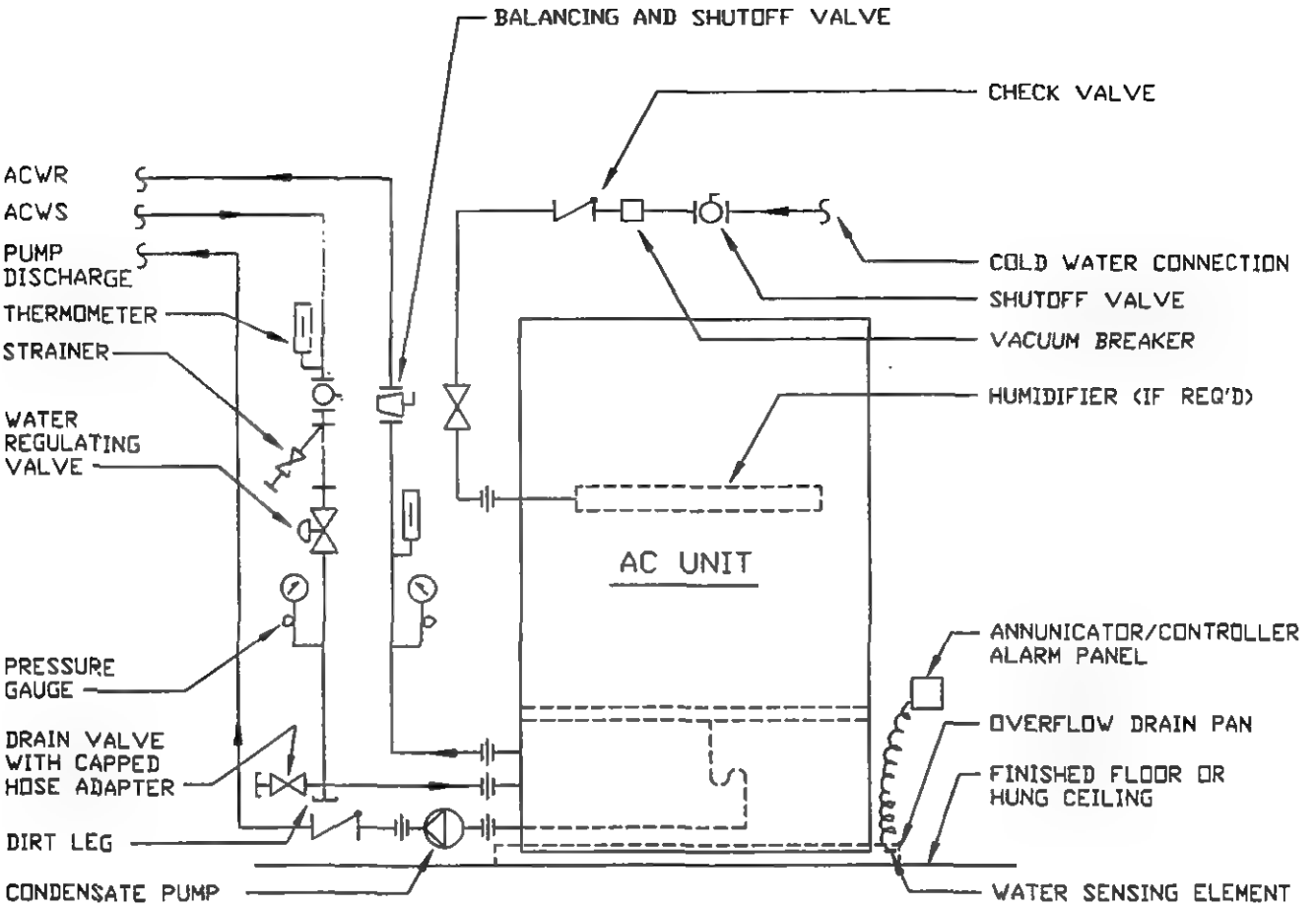
TYPICAL CONDENSER WATER CONNECTION TO CAPPED OUTLETS

SCALE 1/2"=1'-0"

NOTES:

1. THE FULL SIZE SHUTOFF MAIN AND CAPPED OUTLET FOR FUTURE SHALL BE 2-1/2", 3" OR 4", DEPENDING ON THE FLOOR AND THE BUILDING.

2. THIS SKETCH ILLUSTRATES THE BASIC TIE-IN REQUIREMENT ONLY. THE ACTUAL CONDENSER WATER CLOSET PIPING LAYOUT MAY BE DIFFERENT. A FIELD SURVEY OF EXISTING CONDENSER WATER RISER CLOSET OR CONNECTIONS TO VALVED OUTLETS IN HUNG CEILING IS ESSENTIAL.



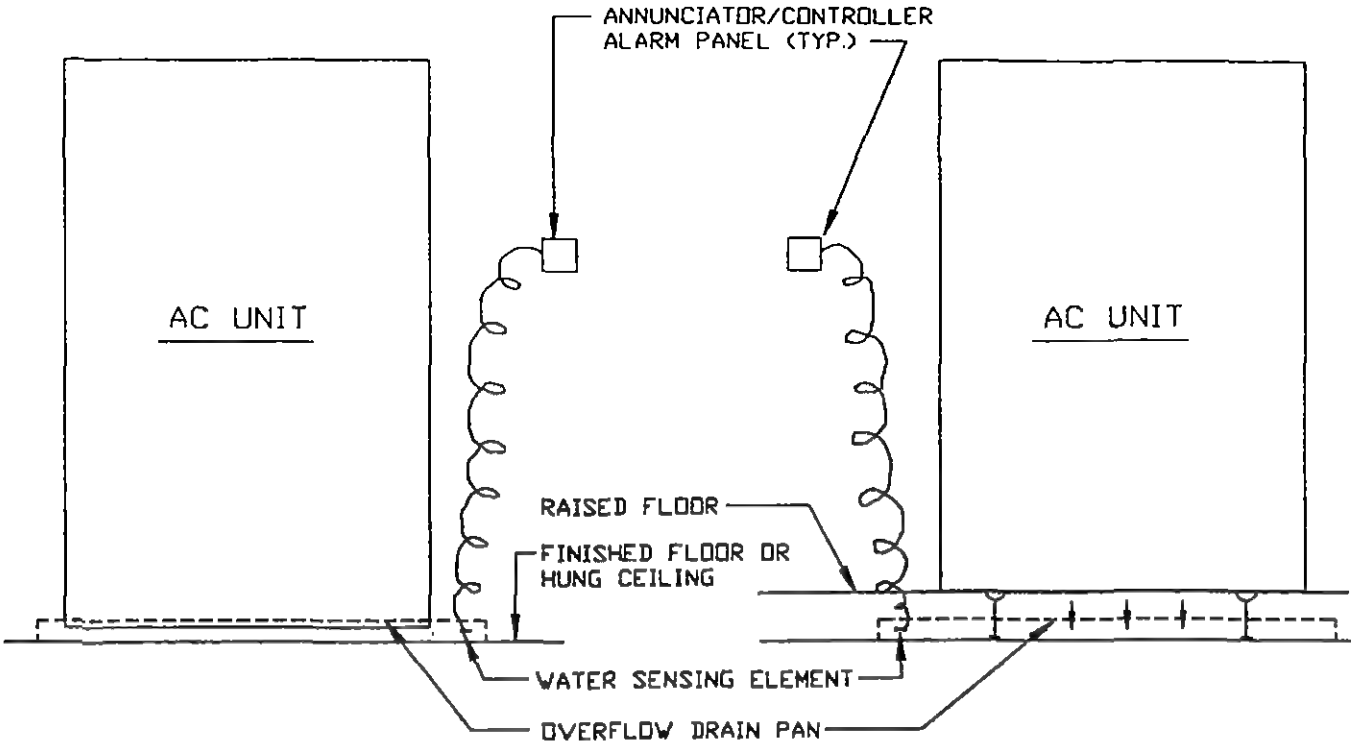
TYPICAL AC UNIT CONDENSER WATER PIPING DIAGRAM

NOT TO SCALE

NOTES:

1. WATER REGULATING VALVE SHALL BE METREX WCCW TYPE, TWO-WAY, REFRIGERANT PRESSURE ACTUATED. IT SHALL BE A POSITIVE SHUTOFF TYPE. SEE GUIDE SPECIFICATION FOR DETAIL.

2. THE COMBINATION SHUTOFF AND BALANCING VALVE SHALL BE A NON-LUBRICATED PLUG VALVE, WITH ADJUSTABLE MEMORY STOP, AS MANUFACTURED BY 'DeZurik'. SEE GUIDE SPECIFICATION FOR DETAIL.



AC UNIT ON FINISHED FLOOR OR IN HUNG CEINING TYPE 'A'

AC UNIT ON RAISED FLOOR TYPE 'B'

REQUIREMENTS FOR OVERFLOW DRAIN PAN UNDER AC UNITS

NOT TO SCALE

PAN MEASUREMENTS

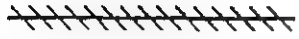
1. MAKE PAN MINIMUM 3" LARGER THAN AC UNIT ON EACH END OF THE FOUR (4) SIDES.
2. MAKE UPSTANDING SIDES 1-1/2" WITH 1/2" HEM TURNED DOWN OUTSIDE OF PAN.
3. USE U.S. 16 GALVANIZED STEEL WITH SOLDERED CORNERS FOR WATER TIGHTNESS.
4. FOR CONDENSATE PAN WITHIN AC UNIT, USE 1-1/4" DRAIN AND ALGAECIDE TABLETS TO MINIMIZE CLOGGING.
5. WHERE RAISED FLOOR APPLIES, INSTALL PAN PRIOR TO INSTALLING RAISED FLOOR.

ALARM MEASUREMENTS

1. SURFACE WATER SENSING ALARM SYSTEM SHALL BE MADE BY DORLEN PRODUCTS INC. WATER SENSOR SHALL BE NON-SELF CONTAINED WATER ALERT TYPE, MODEL SS-R(T) OR SS-1-R(T), WITH REMOTE INDICATOR MODEL R1-2(T) FOR UP TO 6 WATER ALERTS, OR MODEL R1-2(AT) FOR UP TO 12 WATER ALERTS. POWER SUPPLY MODEL PS-3 IS RECOMMENDED FOR WATER ALERTS.
2. USE ALARM EASILY HEARD BY PERSONNEL IN NEARBY CLOSED ROOMS.
3. PLACE DURABLE METAL SIGN PERMANENTLY AFFIXED TO ALARM TO READ: "WHEN ALARM SOUNDS, CALL 435-4164 WEEKDAYS AND WEEKENDS."
4. UNIT SHALL SHUT DOWN UPON ACTIVATION OF ALARM.

FIRE PROTECTION SYMBOL LIST

EXISTING PIPING TO REMAIN



EXISTING PIPING TO BE REMOVED

NEW SPRINKLER PIPING

NEW PREACTION PIPING

NEW SPRINKLER PIPING WITH INSULATION

FIRE STANDPIPE

EXISTING SPRINKLER HEAD TO REMAIN

EXISTING SPRINKLER HEAD TO BE REMOVED

NEW CONCEALED TYPE HEAD

NEW "ON-OFF" UPRIGHT TYPE SPRINKLER HEAD

CONNECT TO EXISTING WORK

BRACKET MOUNTED FIRE EXTINGUISHER (FE)

FIRE EXTINGUISHER CABINET (FEC)

FIRE HOSE CABINET (FHC)

FIRE HOSE RACK IN STAIR (FHR)

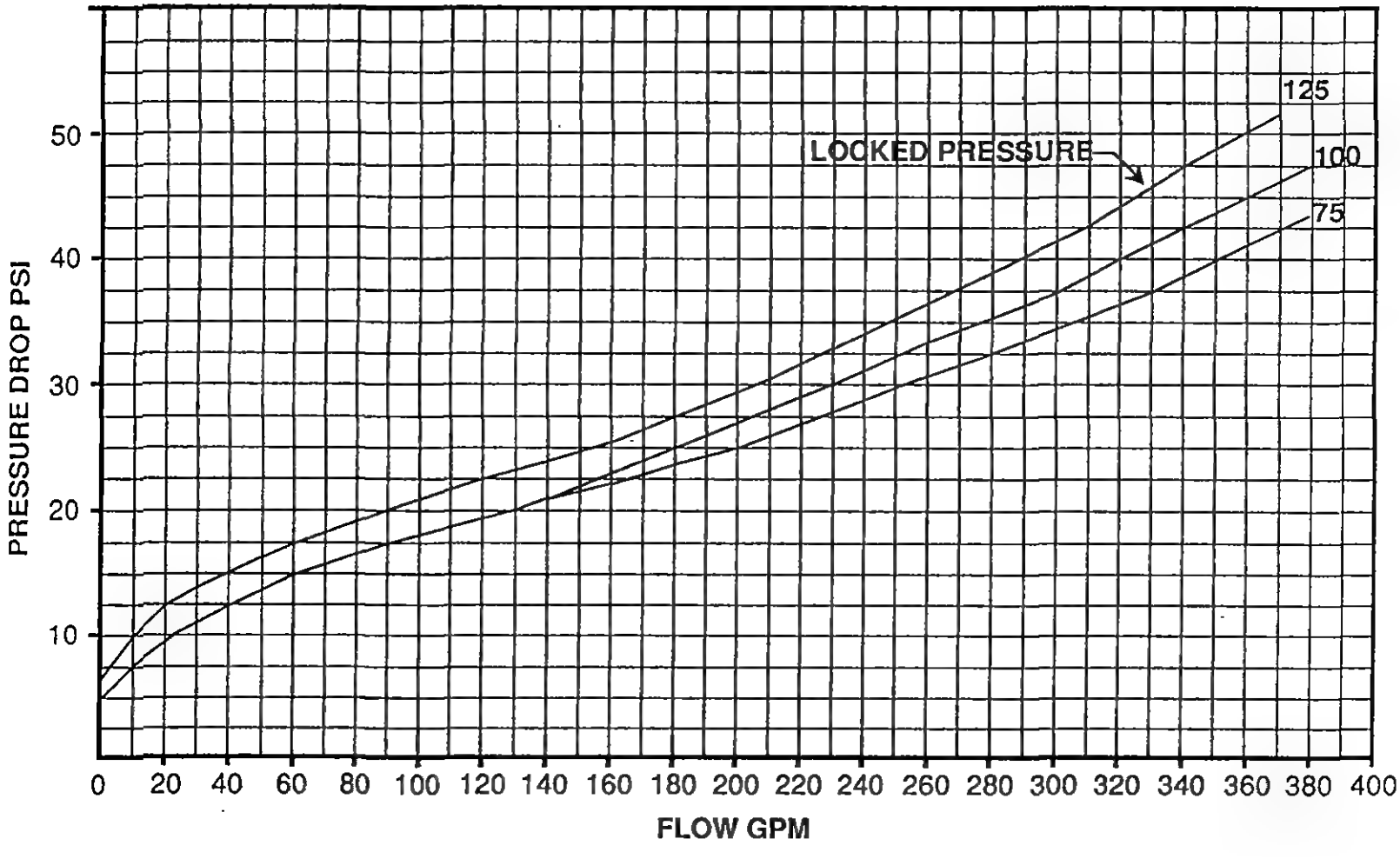
SCHEDULE OF FLOOR CONTROL VALVE ASSEMBLIES

TOWER	FLOOR	RISER DESIGNATION	FLOOR CONTROL VALVE		RELIEF VALVE	REMARKS
			O.S & Y.	COMB. PRESSURE		
A	1st thru 8th	C		•	•	7th & 8th floors have 2–1/2" capped outlet only (No valves required)
A	9th thru 31th	C	•			
A	32nd thru 40th	B		•	•	
A	41st and 42nd	B	NONE REQUIRED			
A	43th thru 75th	B		•	•	
A	76th	B	NONE REQUIRED			
A	77th thru 86th	B		•	•	
A	87th thru 98th	B	•			
A	99th thru 106th	A	•			
B	1st thru 8th	C		•	•	7th & 8th floors have 2 –1/2" capped outlet only (No valves required)
B	9th thru 22nd	C	•			
B	23th thru 31st	C	•			
B	32nd thru 76th	B		•	•	
B	77th thru 79th	B		•	•	See floor plans & riser diagram for riser
B	80th thru85th	B		•		Provide capped outlet after floor control valve
B	86th	B		•	•	
B	87th thru 98th	B	•			
B	99th thru 106th	A	•			

NOTES:

1.The existing floor control valve assemblies are located in the public corridor janitor's closet on each tower floor.

2.The Engineer or Architect of record is responsible to verify in the field all conditions represented in this chart.



GRAPH OF PRESSURE LOSS THRU COMBINATION PRV/SHUT-OFF VALVE POTTER-ROEMER MODEL #400

REGULATING VALVES

The primary function of a regulating valve is to automatically control water pressure under flow and static conditions. The control of pressure also regulates the volume of water delivered. The economies available to the designer are: a reduction of service weight of piping systems past the valve plus the ability to use high pressure express risers and laterals to the valve.

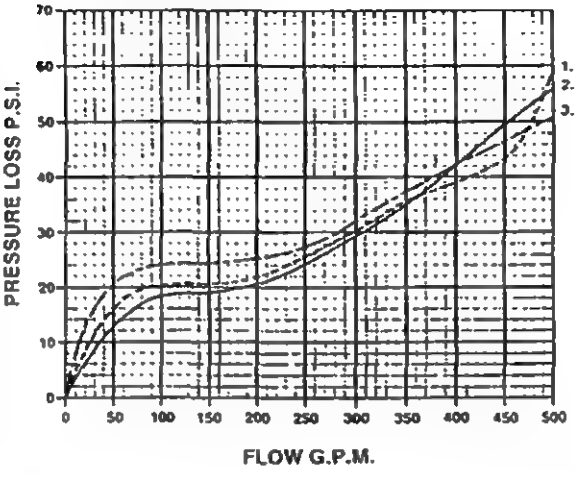
Figure number 4000-4032 regulating valves performance may be calculated by using the nomograph provided on page **4-2**. The pressure loss charts are to provide assistance in calculating performance for the 4033-4038 regulating valves.

STATIC SETTING

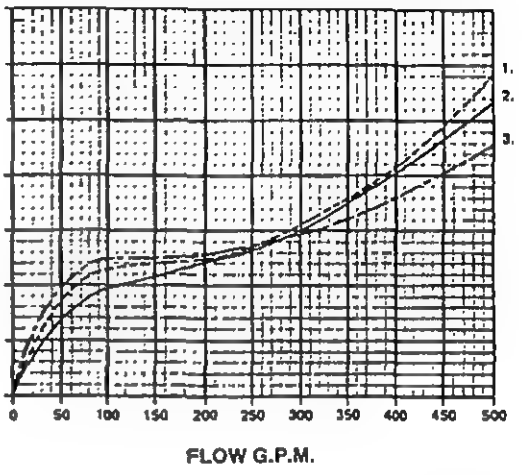
1. VALVE 125 P.S.I.
2. VALVE 100 P.S.I.
3. VALVE 75 P.S.I.

PRESSURE LOSS CHARTS FOR ANGLE PATTERN 4033-4038 VALVES

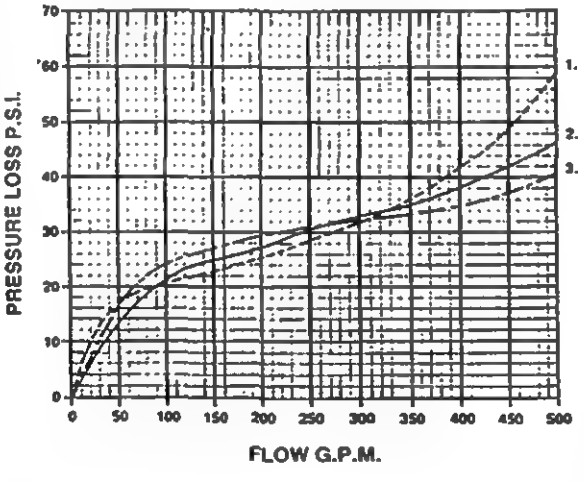
• INLET PRESSURE 150



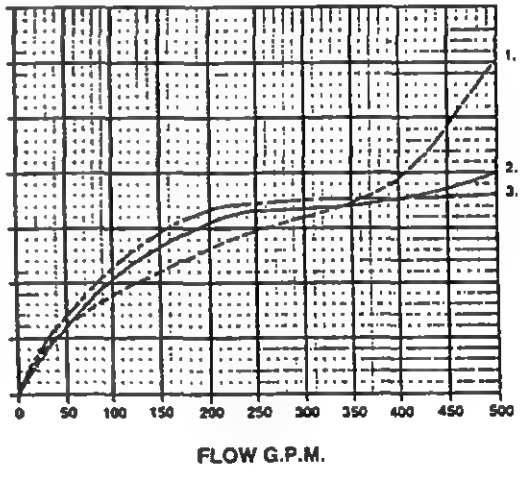
• INLET PRESSURE 200



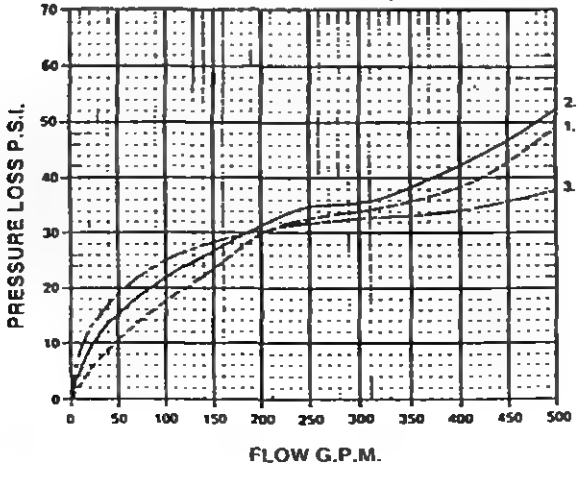
• INLET PRESSURE 250



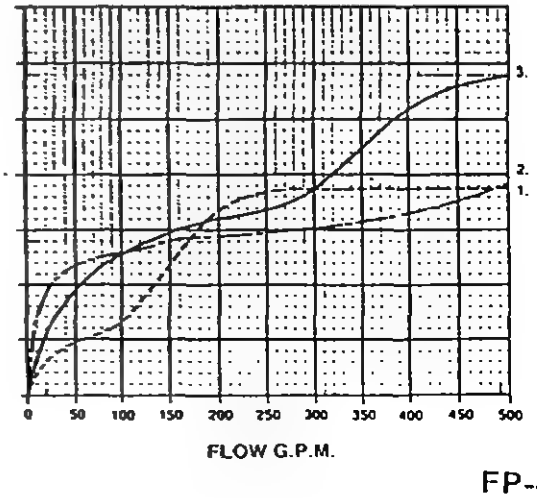
• INLET PRESSURE 300

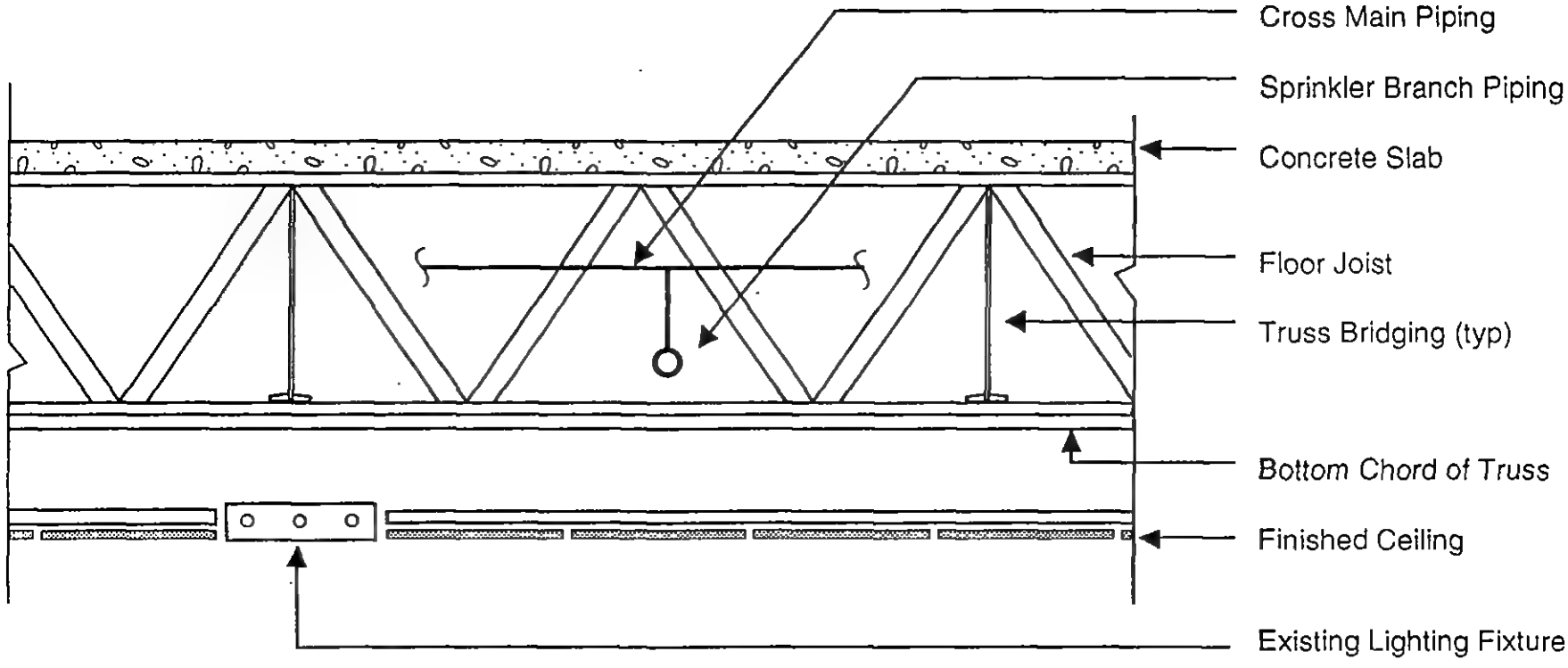


• INLET PRESSURE 350



• INLET PRESSURE 400



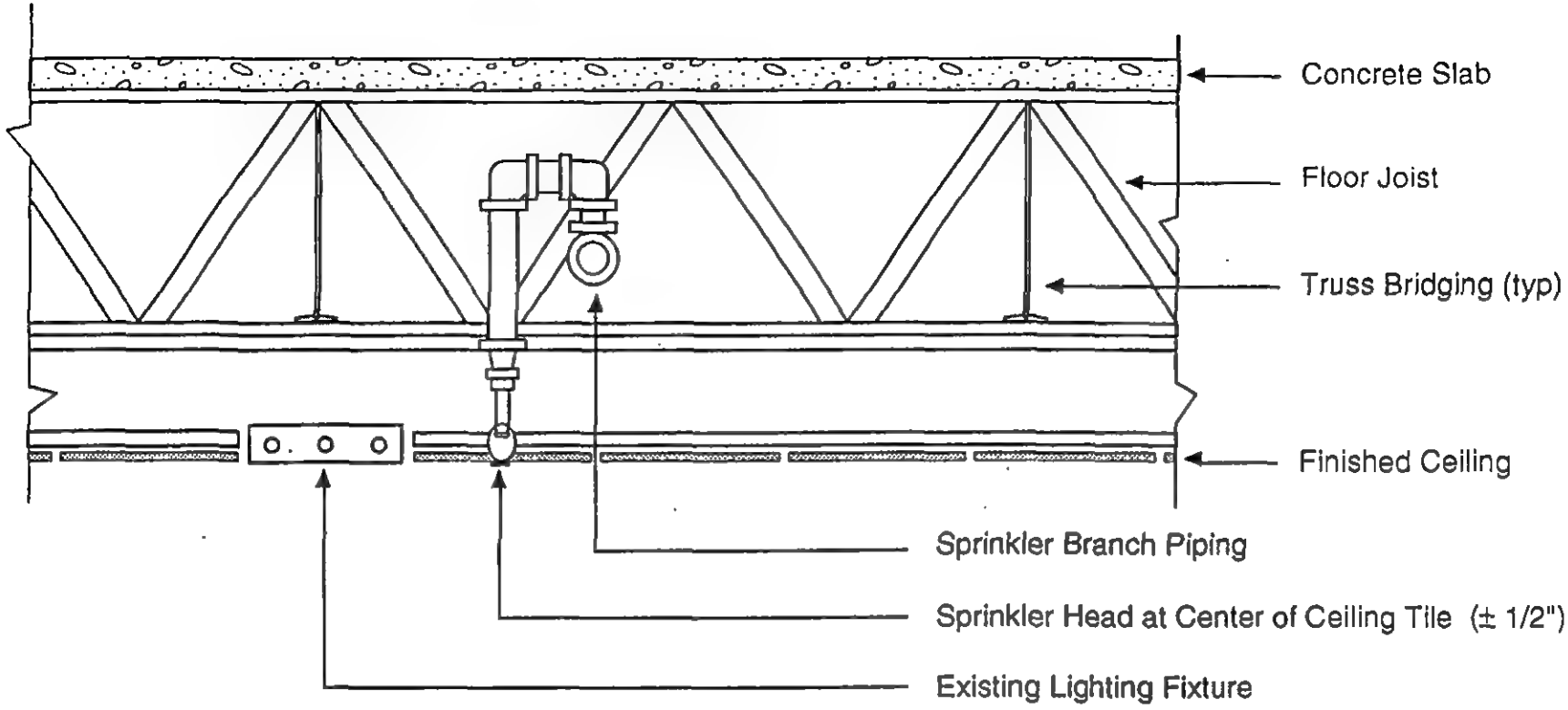


DETAIL OF PIPE LOCATION IN SUSPENDED CEILING

Not to Scale

NOTES:

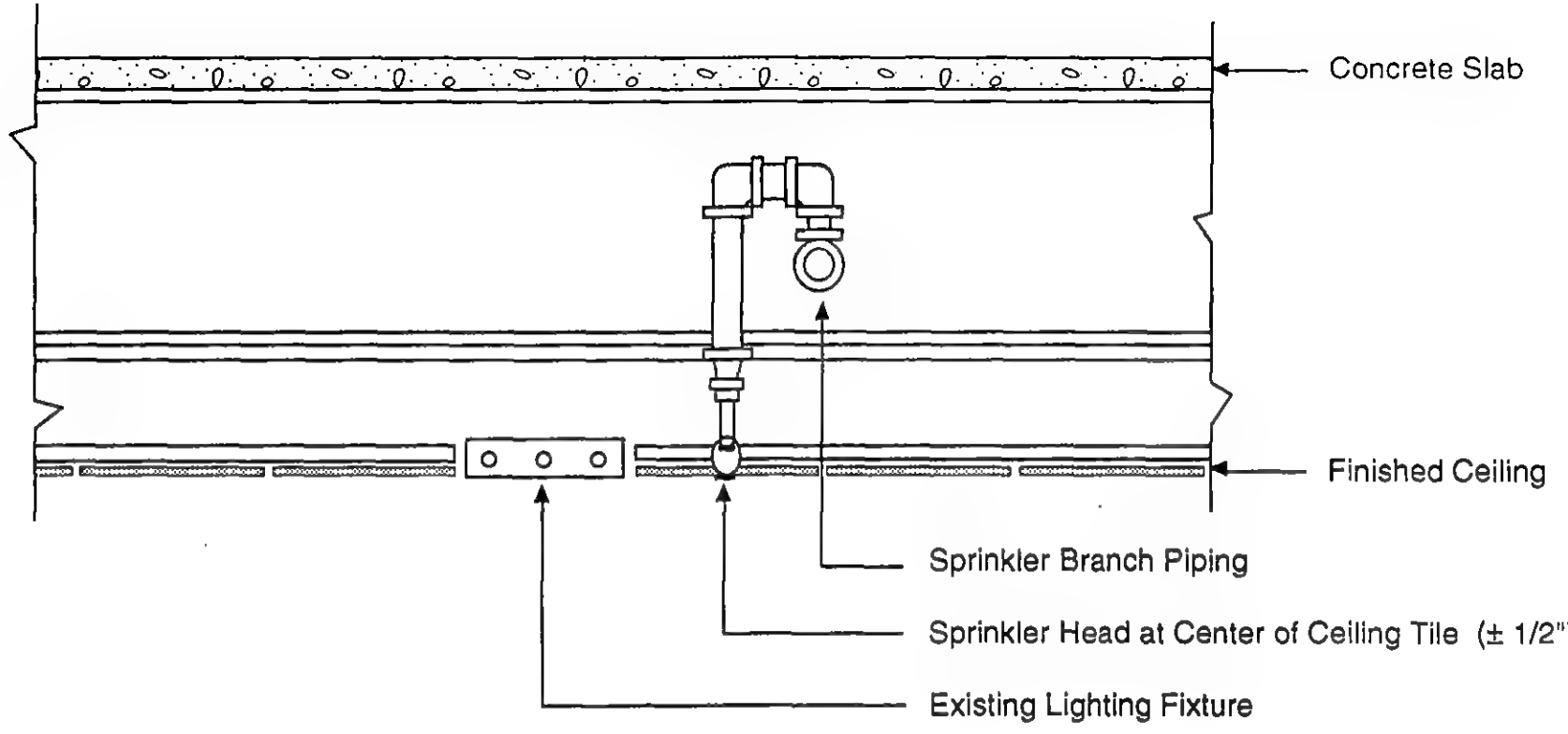
1. This detail applies to 1 WTC and 2 WTC building tower floors only.
2. All sprinkler piping shall be installed above the bottom chord of truss.
3. Branch lines shall run through bridging trusses.



DETAIL OF TYPICAL PIPING CONNECTION TO SPRINKLER Not to Scale

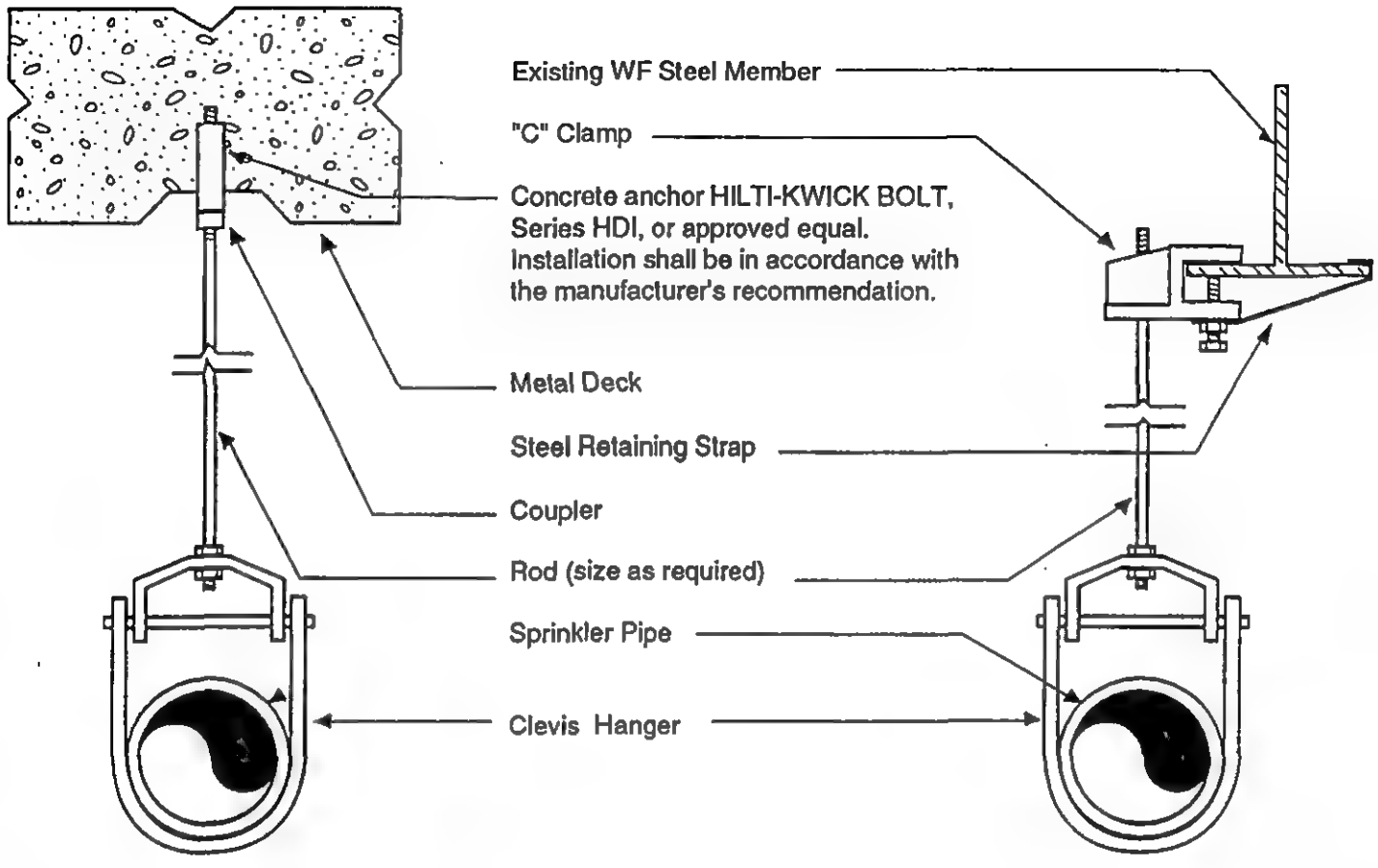
(WITH TRUSS IN THE CEILING)

NOTE:
This detail applies to tower floors of 1 WTC and 2 WTC only. For other areas, refer to WTC-FP-7.



DETAIL OF TYPICAL PIPING CONNECTION TO SPRINKLER Not to Scale

(WITHOUT TRUSS IN THE CEILING)

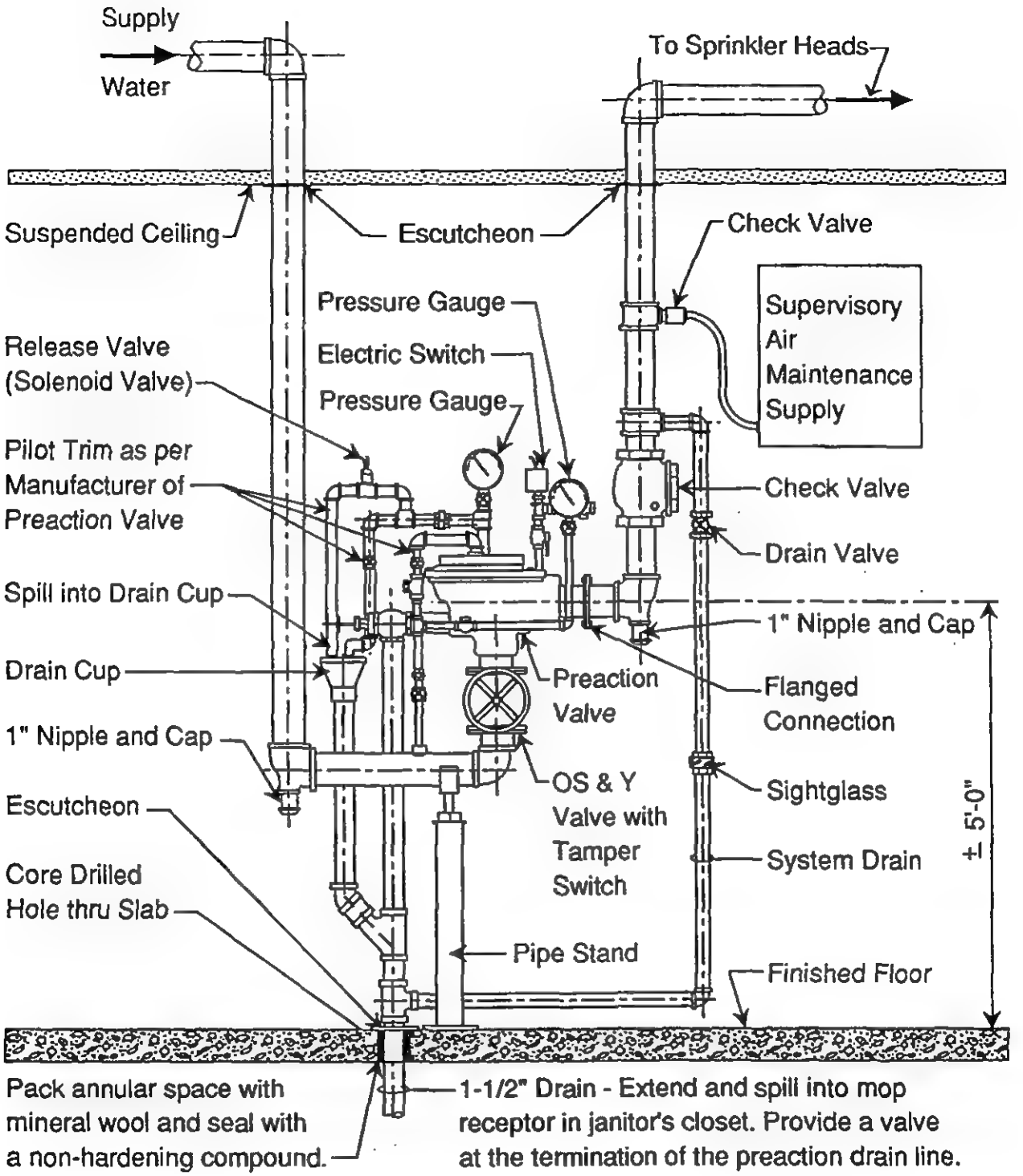


TYPICAL HANGER DETAILS

Not to Scale

NOTES:

1. Clevis hangers required on piping larger than 1".
2. General purpose hangers may be used on 1 " sprinkler piping only.

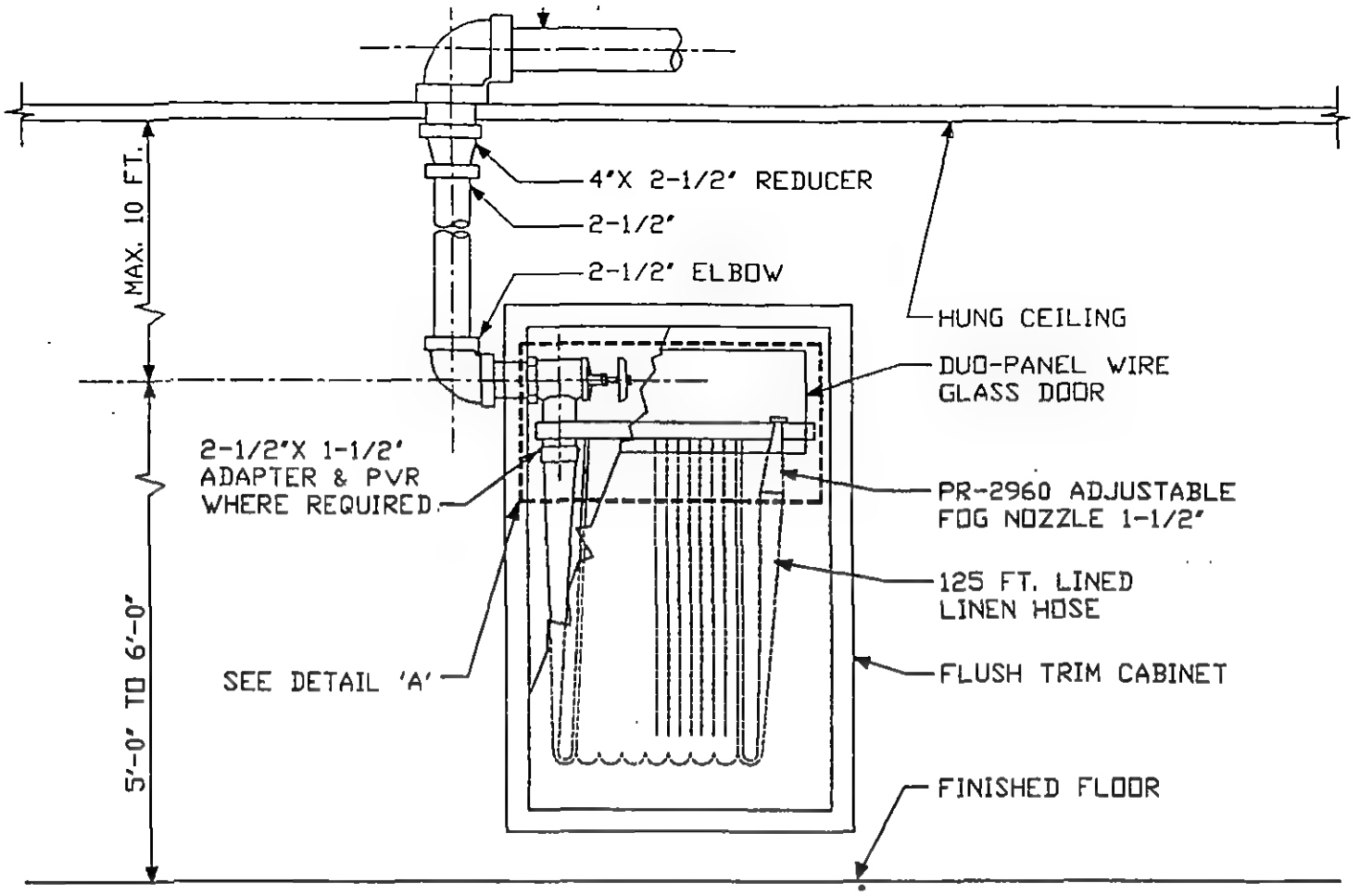


PREACTION VALVE ASSEMBLY DETAIL

Not to Scale

NOTES:

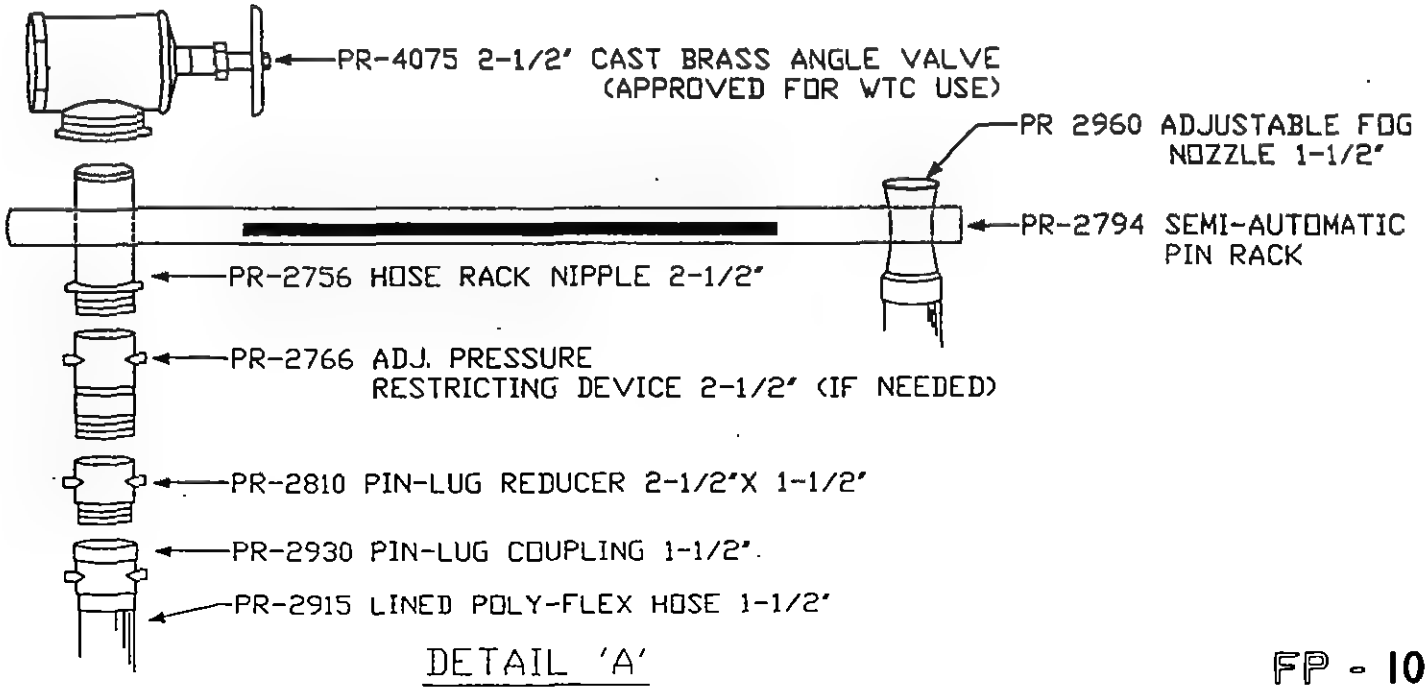
1. This detail applies to both single and multi-tenant floors.
2. The preaction valve assembly shall be installed in the tenant space.



FIRE HOSE CABINET DETAIL NOT TO SCALE

NOTES:

1. FOR EXACT LOCATION OF FIRE HOSE CABINETS, SEE ARCHITECTURAL DRAWINGS.
2. PROVIDE POTTER-ROEMER FIG. 2766, 2-1/2" BRASS ADJUSTABLE PRESSURE REDUCING VALVE WHERE NORMAL HYDROSTATIC PRESSURE AT 1-1/2" HOSE STATION EXCEEDS 85 PSIG.
3. THE FIRE HOSE CABINET SHALL BE POTTER-ROEMER FIG. 1104 SERIES RECESSED WITH 20 GAUGE DOOR OF STYLE "DW" DUO PANEL WIRE GLASS.
4. ALL THREADS SHALL BE N.Y.F.D. APPROVED FOR USE.



DETAIL 'A'

FIRE STANDPIPE ZONE PIPE AND FITTINGS

FOR

1 WTC (Tower A), 2 WTC (Tower B), 4 WTC (SEPB), 5 WTC (NEPB)

Zone	Floor Served	Elevation	Pipe	Fittings
1	Roof thru 102nd	1673' thru 1552'	Standard Weight, Sch.40, Black Steel	350 # W.W.P. Threaded, Cast Iron Class 250
2	101st thru 89th	1540' thru 1396'	Standard Weight, Sch.40, Black Steel	350 # W.W.P. Threaded, Cast Iron Class 250
3	88th thru 76th	1384' thru 1236'	Standard Weight, Sch.40, Black Steel	350 # W.W.P. Threaded, Cast Iron Class 250
4	75th thru 58th	1222' thru 1012'	Extra Strong, Sch. 80, Black Steel	500 # W.W.P. Threaded, Malleable Iron Class 300
5	57th thru 20th	1000' thru 546'	Extra Strong, Sch. 80, Black Steel	800 # W.W.P. Threaded, Malleable Iron Class 300
6	19th thru B6	534' thru 242'	Extra Strong, Sch. 80, Black Steel	1000 # W.W.P. Threaded, Malleable Iron Class 300

Notes:

1. Portion of the data shown in the table are extracted from the base building drawings P-A-88 thru P-A-93 for 1 WTC, P-B-88 thru P-B-93 for 2 WTC, P-F-38 for 4 WTC, and P-E-44 for 5 WTC.
2. For 4 WTC, 5 WTC & Concourse Area, use Zone 6 requirements.
3. For Zone 4, 5, and 6, Victaulic style 77 couplings and grooved end fittings may be used for sizes 4 in. and larger where threaded fittings are not available. Those fittings must have a pressure ratings of 1000 wwp for sizes 4 in. and 6 in., and 800 wwp for size 8 in.

11/24/97

Setting Number for Potter Roemer 2 1/2" Pressure Restricting Valve
Model # PR-2766

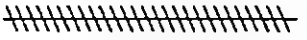
					Tower A							
	Setting	Pressure	Elevation		Setting	Pressure	Elevation		Setting	Pressure	Elevation
Floor	Number	(psi)	(Ft)	Floor	Number	(psi)	(Ft)	Floor	Number	(psi)	(Ft)
B6	7	132.56	242	40	NO PRV	13.00	786.00	85	7	135.03	1348.00
B5	7	127.80	253	41	NO PRV	6.80	800.00	86	7	129.84	1360.00
B4	7	123.04	264	42	4	183.58	814.00	87	7	124.64	1372.00
B3	8	118.71	274	43	4	177.52	828.00	88	8	119.45	1384.00
B2	8	114.38	284	44	5	171.46	842.00	89	8	114.25	1396.00
B1	8	110.05	294	45	5	165.40	856.00	90	8	109.06	1408.00
1	9	103.12	310	46	5	160.21	868.00	91	9	103.86	1420.00
2	10	93.60	332	47	6	155.01	880.00	92	9	98.67	1432.00
3	10	88.31	344	48	6	149.82	892.00	93	10	93.47	1444.00
4	NO PRV	83.55	355	49	6	144.62	904.00	94	10	88.28	1456.00
5	NO PRV	78.36	367	50	6	139.43	916.00	95	NO PRV	83.08	1468.00
6	NO PRV	73.38	378.5	51	7	134.23	928.00	96	NO PRV	77.89	1480.00
7	NO PRV	68.40	390	52	7	129.04	940.00	97	NO PRV	72.69	1492.00
8	4	179.23	402	53	7	123.84	952.00	98	NO PRV	67.50	1504.00
9	5	174.04	414	54	8	118.65	964.00	99	NO PRV	62.40	1516.00
10	5	168.84	426	55	8	113.45	976.00	100	NO PRV	57.21	1528.00
11	5	163.65	438	56	9	108.26	988.00	101	NO PRV	52.01	1540.00
12	5	158.45	450	57	9	103.06	1000.00	102	NO PRV	46.82	1552.00
13	6	153.26	462	58	9	97.87	1012.00	103	NO PRV	41.62	1564.00
14	6	148.07	474	59	10	92.67	1024.00	104	NO PRV	36.43	1576.00
15	6	142.87	486	60	10	87.48	1036.00	105	NO PRV	31.23	1588.00
16	6	137.68	498	61	NO PRV	82.29	1048.00	106	NO PRV	26.00	1600.00
17	7	132.48	510	62	NO PRV	77.09	1060.00	107	NO PRV	19.80	1614.30
18	7	127.29	522	63	NO PRV	71.90	1072.00	108	NO PRV	12.20	1631.80
19	7	122.09	534	64	NO PRV	66.70	1084.00	109	NO PRV	8.60	1646.80
20	8	116.90	546	65	NO PRV	61.51	1096.00	110	NO PRV	1.30	1657.50
21	8	111.70	558	66	NO PRV	56.31	1108.00	roof			varies
22	9	106.51	570	67	NO PRV	51.12	1120.00				
23	9	101.31	582	68	NO PRV	44.19	1136.00				
24	10	96.12	594	69	NO PRV	39.00	1148.00				
25		90.92	606	70	NO PRV	33.80	1160.00				
26	NO PRV	85.73	618	71	NO PRV	28.61	1172.00				
27	NO PRV	80.53	630	72	NO PRV	23.41	1184.00				
28	NO PRV	75.34	642	73	NO PRV	18.22	1196.00				
29	NO PRV	70.14	654	74	NO PRV	13.02	1208.00				
30	NO PRV	64.95	666	75	NO PRV	6.96	1222.00				
31	NO PRV	59.75	678	76	NO PRV	0.90	1236.00				
32	NO PRV	54.56	690	77	4	177.45	1250.00				
33	NO PRV	49.36	702	78	5	172.26	1262.00				
34	NO PRV	44.17	714	79	5	166.20	1276.00				
35	NO PRV	38.97	726	80	5	161.00	1288.00				
36	NO PRV	33.78	738	81	6	155.81	1300.00				
37	NO PRV	28.58	750	82	6	150.61	1312.00				
38	NO PRV	23.39	762	83	6	145.42	1324.00				
39	NO PRV	18.19	774	84	6	140.22	1336.00				

Setting Number for Potter Roemer 2 1/2" Pressure Restricting Valve
Model # PR-2766

				Tower B							
	Setting	Pressure	Elevation		Setting	Pressure	Elevation		Setting	Pressure	Elevatio
Floor	Number	(psi)	(Ft)	Floor	Number	(psi)	(Ft)	Floor	Number	(psi)	(Ft)
B6	7	132.47	242	40	NO PRV	12.86	786.00	85	7	135.09	1342.(
B5	7	127.71	253	41	NO PRV	6.80	800.00	86	7	129.90	1354.(
B4	7	122.95	264	42	4	181.16	814.00	87	7	124.70	1366.(
B3	8	118.62	274	43	5	175.10	828.00	88	8	119.51	1378.(
B2	8	114.29	284	44	5	169.73	840.00	89	8	114.31	1390.(
B1	8	109.96	294	45	5	163.67	854.00	90	8	109.12	1402.(
1	9	103.03	310	46	6	158.48	866.00	91	9	103.92	1414.(
2	10	93.51	332	47	6	153.28	878.00	92	9	98.73	1426.(
3	10	88.31	344	48	6	148.09	890.00	93	10	93.53	1438.(
4	NO PRV	83.55	355	49	6	142.89	902.00	94	10	88.34	1450.(
5	NO PRV	78.36	367	50	6	137.70	914.00	95	NO PRV	83.14	1462.(
6	NO PRV	73.38	378.5	51	7	132.50	926.00	96	NO PRV	77.95	1474.(
7	NO PRV	68.40	390	52	7	127.31	938.00	97	NO PRV	72.75	1486.(
8	4	179.24	402	53	7	122.11	950.00	98	NO PRV	67.56	1498.(
9	5	174.04	414	54	8	116.92	962.00	99	NO PRV	62.36	1510.(
10	5	168.85	426	55	8	111.72	974.00	100	NO PRV	57.17	1522.(
11	5	163.65	438	56	9	106.53	986.00	101	NO PRV	51.97	1534.(
12	5	158.46	450	57	9	101.33	998.00	102	NO PRV	46.78	1546.(
13	6	153.26	462	58	10	96.14	1010.00	103	NO PRV	41.58	1558.(
14	6	148.07	474	59	10	90.94	1022.00	104	NO PRV	36.39	1570.(
15	6	142.88	486	60	NO PRV	85.75	1034.00	105	NO PRV	31.19	1582.(
16	6	137.68	498	61	NO PRV	80.55	1046.00	106	NO PRV	26.00	1594.(
17	7	132.49	510	62	NO PRV	75.36	1058.00	107	NO PRV	19.80	1608.3
18	7	127.29	522	63	NO PRV	70.16	1070.00	108	NO PRV	12.20	1625.8
19	7	122.10	534	64	NO PRV	64.97	1082.00	109	NO PRV	9.60	1639.8
20	8	116.90	546	65	NO PRV	59.77	1094.00	110	NO PRV	1.30	1651.(
21	8	111.71	558	66	NO PRV	54.58	1106.00	roof			
22	9	106.51	570	67	NO PRV	49.38	1118.00				
23	9	101.32	582	68	NO PRV	44.19	1130.00				
24	10	96.12	594	69	NO PRV	39.00	1142.00				
25	10	90.93	606	70	NO PRV	33.80	1154.00				
26	NO PRV	85.73	618	71	NO PRV	28.61	1166.00				
27	NO PRV	80.54	630	72	NO PRV	23.41	1178.00				
28	NO PRV	75.34	642	73	NO PRV	18.22	1190.00				
29	NO PRV	70.15	654	74	NO PRV	13.02	1202.00				
30	NO PRV	64.95	666	75	NO PRV	6.96	1216.00				
31	NO PRV	59.76	678	76	NO PRV	0.90	1230.00				
32	NO PRV	54.56	690	77	4	177.51	1244.00				
33	NO PRV	49.37	702	78	5	172.31	1256.00				
34	NO PRV	44.17	714	79	5	166.25	1270.00				
35	NO PRV	38.98	726	80	5	161.06	1282.00				
36	NO PRV	33.78	738	81	6	155.86	1294.00				
37	NO PRV	28.59	750	82	6	150.67	1306.00				
38	NO PRV	23.39	762	83	6	145.47	1318.00				
39	NO PRV	18.20	774	84	6	140.28	1330.00				

PLUMBING SYMBOL LIST

EXISTING PIPING TO REMAIN


EXISTING PIPING TO BE REMOVED

NEW WASTE PIPING (W)

NEW INDIRECT WASTE PIPING (IW)

NEW VENT PIPING (V)

NEW COLD WATER PIPING (C.W.)

NEW HOT WATER PIPING (H.W.)

NEW HOT WATER CIRCULATION PIPING

NEW PLUGGED OUTLET

NEW CAPPED OUTLET

PIPE UP UNLESS OTHERWISE NOTED

PIPE DROP UNLESS OTHERWISE NOTED

CONNECTION TO EXISTING WORK

GATE VALVE

PRESSURE REDUCING VALVE (PRV)

BALL VALVE

CHECK VALVE

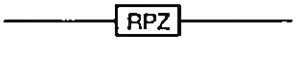
VACUUM BREAKER

WATER METER

DRINKING FOUNTAIN

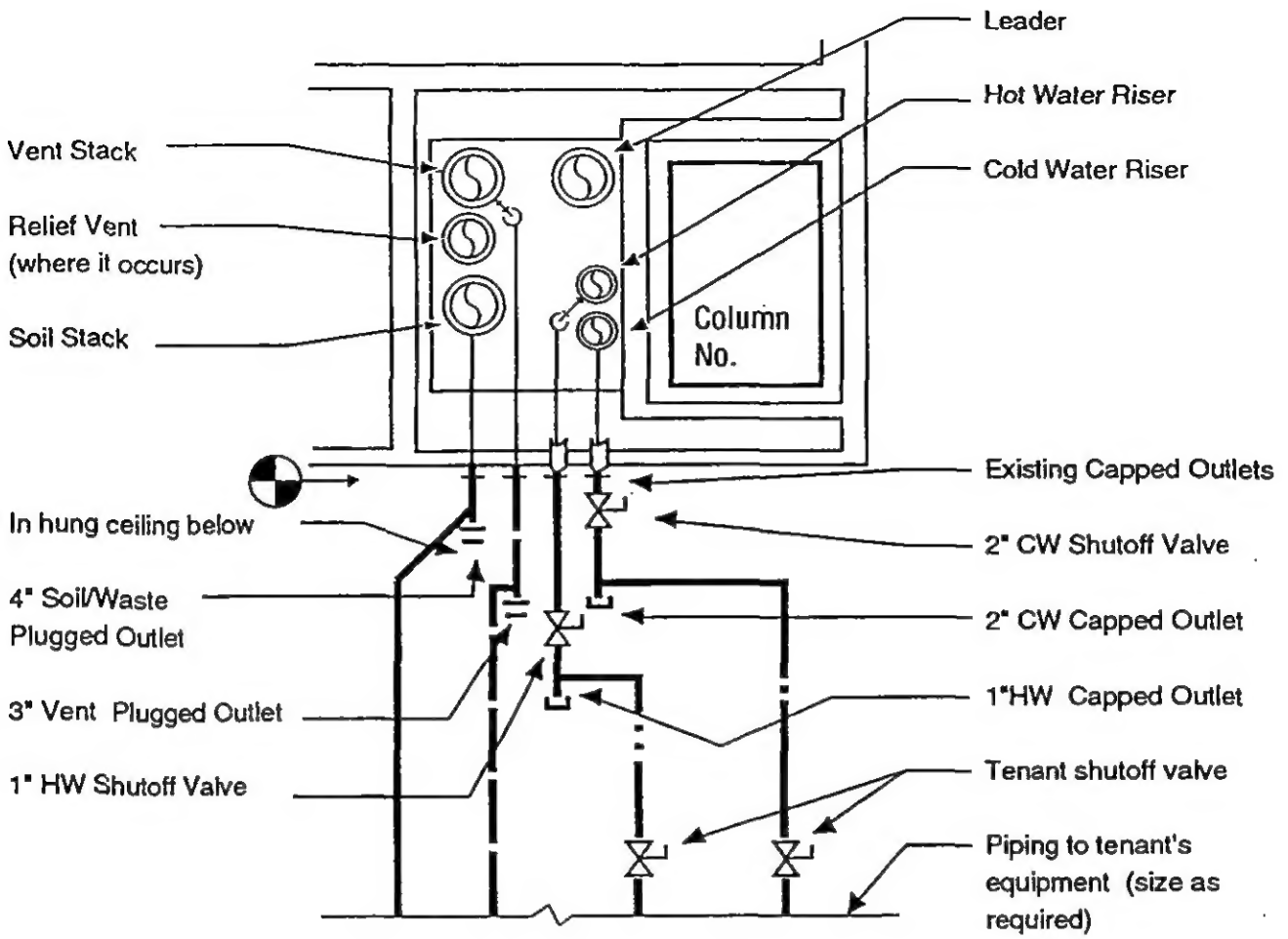
TRAP PRIMER (TP)

SINK



REDUCED PRESSURE BACKFLOW PREVENTOR

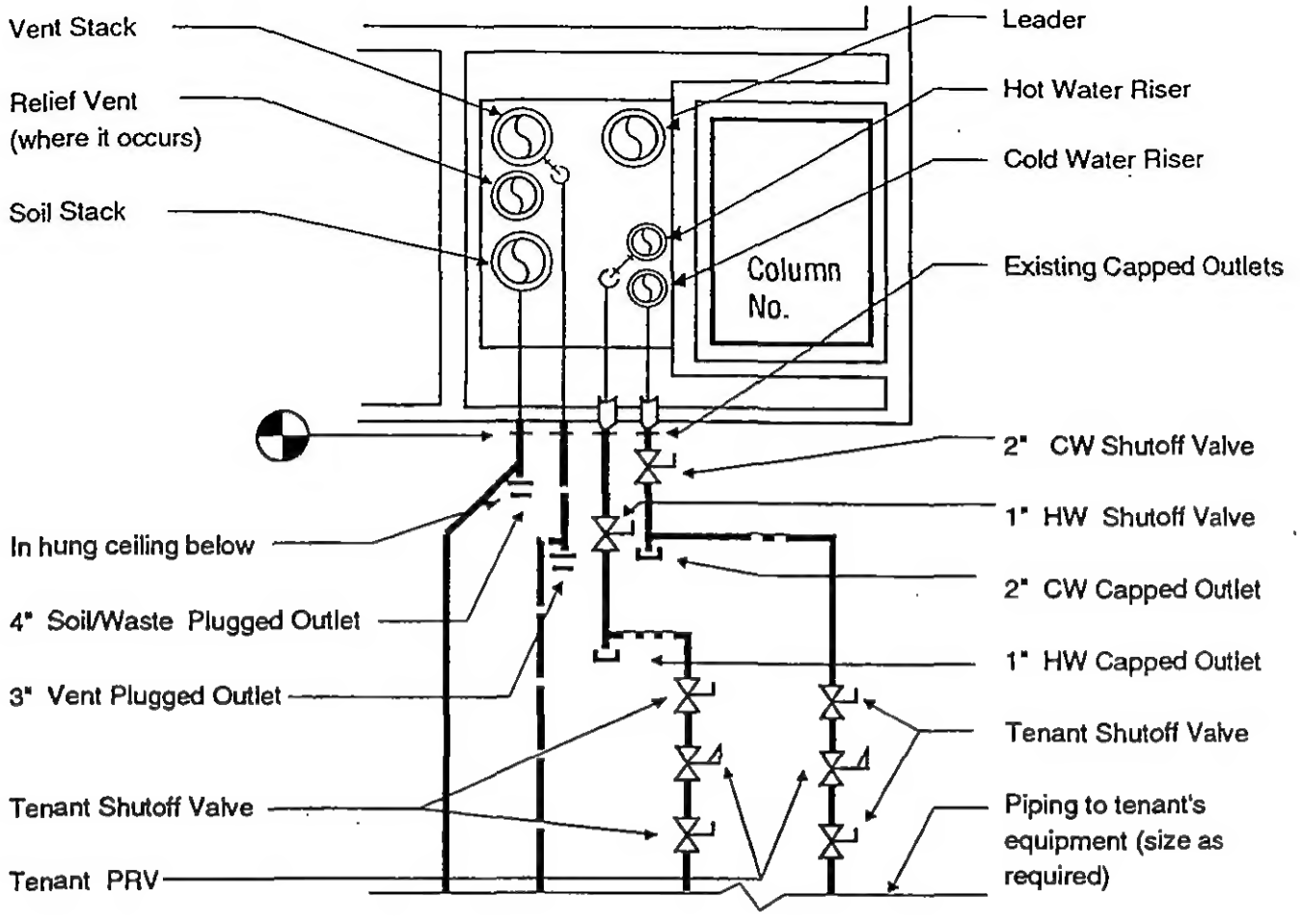
FLOOR DRAIN



SCHEMATIC OF PIPING CONNECTIONS AT WET COLUMN (WITHOUT PRV INSTALLATION) Not to Scale

Notes:

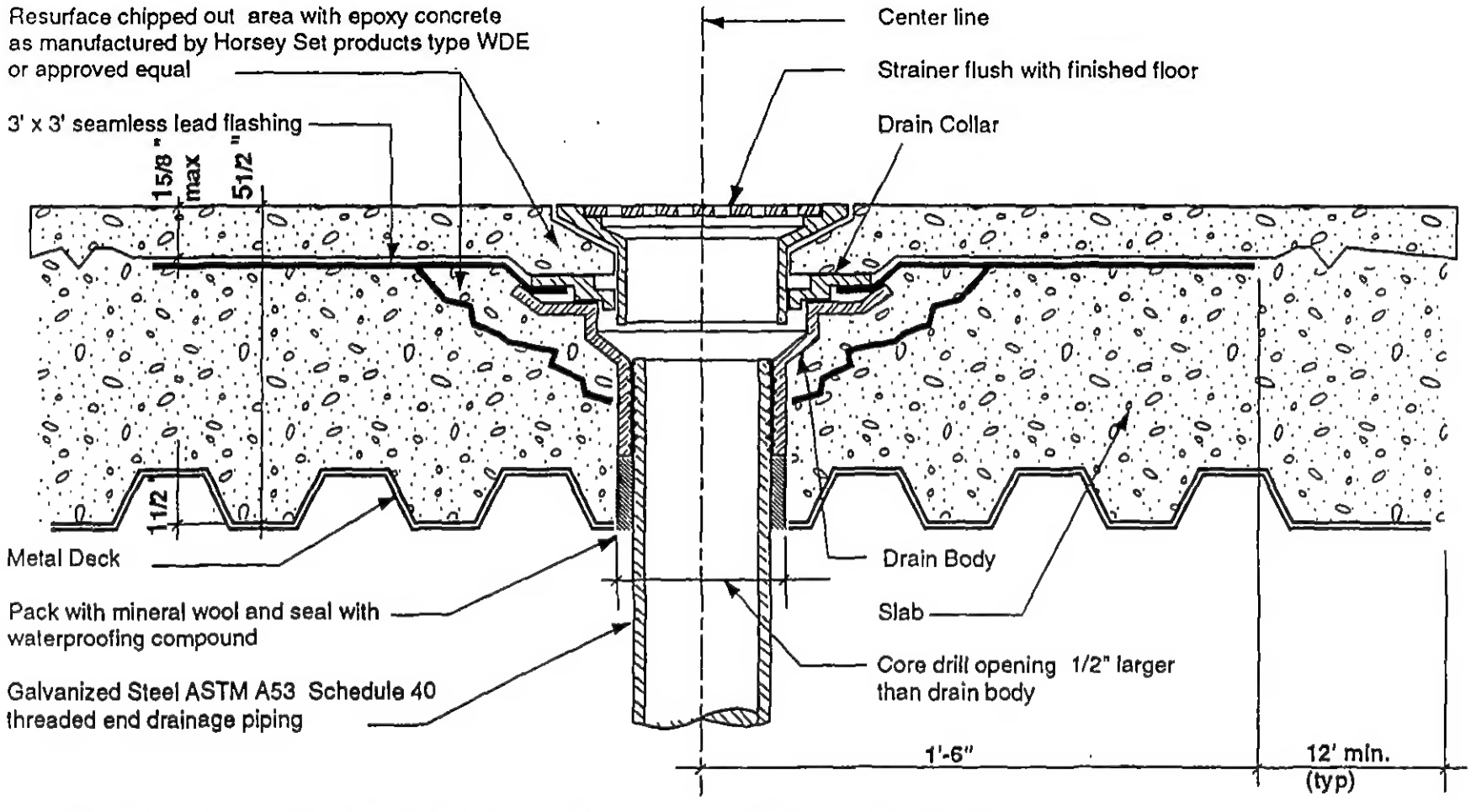
1. Size of existing piping may vary depending on the floor and the building.
2. All tie-ins to the existing capped/plugged outlets shall be full size with a provision for future capped/plugged outlets.
3. Shutoff valves (ball valves) shall be provided for the main takeoff and the branch main to the tenant system.
4. Provide a tag on valves to indicate the tenant's name. Refer to the Guide Specification for further detail.



SCHEMATIC OF PIPING CONNECTIONS AT WET COLUMN (WITH PRV INSTALLATION) Not to Scale

Notes:

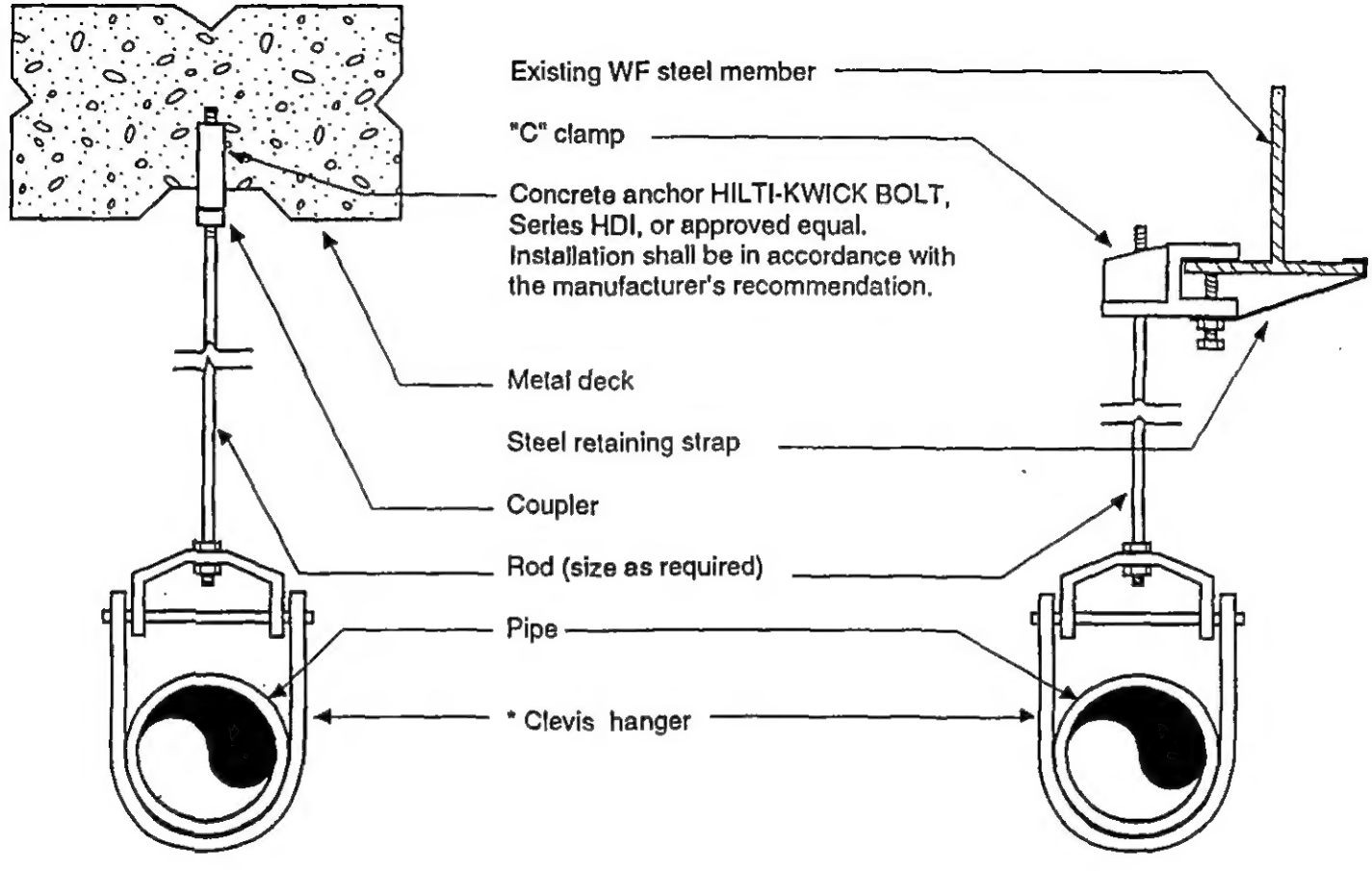
1. Size of existing piping may vary depending on the floor and the building.
2. All tie-ins to the existing capped/plugged outlets shall be full size with a provision for future capped/plugged outlets.
3. Shutoff valves(ball valves) shall be provided for the main takeoff and branch main to the tenant system.
4. Provide a tag on valves to indicate the tenant's name. Refer to the Guide Specification for further detail.
5. PRVs are required on the floors where the base building working pressure is equal to or greater than 85 psig. Refer to the base building riser diagram drawings P-A-82, P-A-87, P-B-82, and P-B-87 for listing of working pressures.
6. A constant downstream pressure type of PRV shall be specified. Refer to the Guide Specification for further detail.



TYPICAL FLOOR DRAIN INSTALLATION DETAIL Not to Scale

Notes

1. Waterproof existing floor of room where floor drain is to be located using Thoroseal sealant or approved equal.
2. Floor drain shown is based on Jay R. Smith, Series 2010 with threaded outlet. Actual selection of the floor drain shall be based on intended application.



TYPICAL HANGER DETAILS

Not to scale

* *Clevis hangers required on piping larger than 1".*
General purpose hangers may be used on piping 1" or smaller.